VOL. 5 NO. 24
December 31, 1980

Energy Research Abstracts

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Technical Information Center
UNITED STATES DEPARTMENT OF ENERGY

CURRENT AWARENESS PUBLICATIONS ON ENERGY

To provide complete coverage of literature related to major Department programs, announcement publications are regularly issued which are comprehensive in their coverage of certain energy fields. All information in these publications, plus additional backup information, is included in the energy data base of the Technical Information Center; all references are also available for machine searching via the on-line retrieval system, DOE/RECON. Descriptions of these current awareness publications, which are supported either directly or indirectly by the DOE, appear below.

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ENERGY RESEARCH ABSTRACTS

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Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers, and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.

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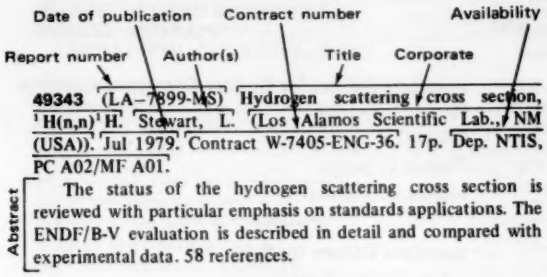
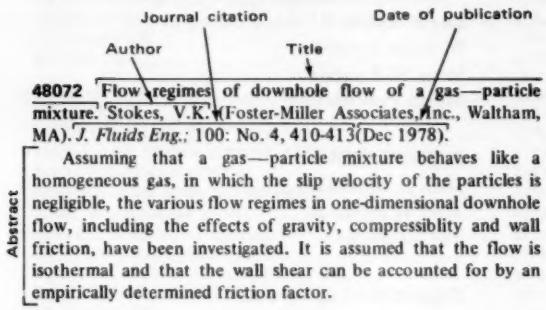

Date of publication
Contract number
Availability
Report number
Author(s)
Title
Corporate
49343 (LA–7899-MS) Hydrogen scattering cross section, ¹H(n,n)¹H. Stewart, L. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 17p. Dep. NTIS, PC A02/MF A01.
Abstract
The status of the hydrogen scattering cross section is reviewed with particular emphasis on standards applications. The ENDF/B-V evaluation is described in detail and compared with experimental data. 58 references.


Journal citation
Date of publication
Author
Title
48072 Flow regimes of downhole flow of a gas—particle mixture. Stokes, V.K. (Foster-Miller Associates, Inc., Waltham, MA). J. Fluids Eng.; 100: No. 4, 410-413 (Dec 1978).
Abstract
Assuming that a gas—particle mixture behaves like a homogeneous gas, in which the slip velocity of the particles is negligible, the various flow regimes in one-dimensional downhole flow, including the effects of gravity, compressiblity and wall friction, have been investigated. It is assumed that the flow is isothermal and that the wall shear can be accounted for by an empirically determined friction factor.

•INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA)*. These indexes are cumulated semiannually and annually. Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

•Corporate Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

49343 (LA–7899-MS) Hydrogen scattering cross section, ¹H(n,n)¹H. Stewart, L. (Los Alamos Scientific Lab., NM (USA)). Jul 1979. Contract W-7405-ENG-36. 17p. Dep. NTIS, PC A02/MF A01.

is indexed as:

Los Alamos Scientific Lab., NM (USA)
Advanced laser fusion target fabrication research and development proposal, 4:48249 (LA–7619-P)
Hydrogen scattering cross section, ¹H(n,n)¹H, 4:49343 (LA–7899-MS)

•Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Stewart, L., Hydrogen scattering cross section, ¹H(n,n)¹H, 4:49343 (LA–7899-MS)
Stewart, M.D., *See* McInroy, J.F., 4:49280
Stewart, W., *See* Dean, J.W., 4:48543
Stimson, J., Reproduction, growth, and survival of Enewetak corals, 4:49200 (NVO–0703-1, pp 56-59)

•Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

HYDROGEN I TARGET/NEUTRON REACTIONS
Hydrogen scattering cross section, ¹H(n,n)¹H (Above 100 keV, review), 4:49343 (LA–7899-MS)
HYDROGEN NITRATES
See NITRIC ACID
HYDROLOGY/RESEARCH PROGRAMS
Inventory of advanced energy technologies and energy conservation research and development: 1976-1978. Volume II. Prepared for the Committee on Science and Technology, U.S. House of Representatives, Ninety-Sixth Congress, 4:48749

•Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

W-7405-ENG-36	Los Alamos Scientific Lab., NM (USA)	
	3:49698	LA-tr–78-45
	3:49857	LA–7224T
	3:49863	LA–7235-MS
W-7405-ENG-48	California Univ., Livermore (USA). Lawrence Livermore Lab.	
	3:49386	UCRL–52456
	3:49431	UCRL–52405

•Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. While not reports, patents and conference papers are indexed here as a matter of convenience.

LA-		
7899-MS	4:49343	Dep. NTIS, PC A02/MF A01
LA-tr-		
78-69	4:48158	Dep. NTIS, PC A03/MF A01

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ENERGY RESEARCH ABSTRACTS

COAL AND COAL PRODUCTS

PROCESSING

REFER ALSO TO CITATION(S) 37555

37460 (ORNL—5665, pp 3-33) **Coal-related research, organic chemistry, and catalysis.** Jul 1980.

In Chemistry Division annual progress report, February 29, 1980.

Coal chemistry research topics included: H exchange at 400°C, breaking C-C bonds in coal, molecular weight estimation using small-angle neutron scattering, ^{13}C NMR spectra of coals, and tunneling during H/D isotope effects. Studies of coal conversion chemistry included thermolysis of bibenzyl and 1-naphthol, heating of coals in phenol, advanced indirect liquefaction based on Koelbel slurry Fischer-Tropsch reactor, and plasma oxidation of coal minerals. Reactions of PAHs in molten $SbCl_5$, a hydrocracking catalyst, were studied. Finally, heterogeneous catalysis (desulfurization etc.) was studied using Cu, Au, and Ni surfaces. 7 figures, 6 tables. (DLC)

37461 (PB—80-128572) **Patent profiles: synthetic fuels.** (Patent and Trademark Office, Washington, DC (USA). Office of Technology Assessment and Forecast). Dec 1979. 233p. NTIS, PC A11/MF A01.

In an effort to continually provide data in a form which is useful and convenient to the interested reader, OTAF is now presenting a new publication series -- PATENT PROFILES. Each of these publications will deal with a specific technological area and will survey the patent activity of that area for a given period of time. This patent profile deals with the following subject areas: In Situ conversion--(Mines and wells); In Vitro conversion--(Obtaining liquid hydrocarbons, Obtaining fuel gas, and Processes involving synthesis gas).

DESULFURIZATION AND PURIFICATION

REFER ALSO TO CITATION(S) 37516, 37517, 37579

37462 (PB—80-121411) **Preservation of Reactor Test Unit and desulfurization of gob pile samples. Final report, Jun 1978-Jul 1979.** Hart, W.D.; McClanathan, L.C.; Meyers, R.A.; Wever, D.M. (TRW Defense and Space Systems Group, Redondo Beach, CA (USA)). Nov 1979. Contract EPA-68-02-1880. 190p. NTIS, PC A09/MF A01.

The report gives results of preservation and desulfurization studies associated with the Reactor Test Unit (RTU), an 8-ton per day test plant used in the EPA-sponsored development of the Meyers Process for ferric sulfate leaching of pyritic sulfur from coal. RTU operation in 1977 and 1978 showed that it could be run continuously on three shifts to reduce the sulfur content of the feed coal to meet the 1.2 lb SOx Emission Standard for New Stationary Sources. Corrosion was encountered in the stainless steel main reactor vessel which required modification prior to further testing. The present program provides a complete corrosion assessment, established specifications for a tail-end elemental sulfur extraction unit, and developed maintenance and upkeep requirements for the RTU. A Meyers Process modification, involving a preliminary float and sink operation in the ferric sulfate leach solution, followed by Meyers processing of the sink (high pyrite) fraction was investigated at bench scale. Experimental verification and applicability assessment of this new approach was performed on both coal wastes and Eastern Interior Basin run-of-mine coal.

37463 (PB—80-123466) **Desulfurization of fossil fuels. Interim progress report, 1 Jul 1972-30 Jun 1973.** Kwart, H.; Gates, B.C.; Schuit, G.A. (Delaware Univ., Newark (USA). Dept. of Chemical Engineering). 1973. 29p. NTIS, PC A03/MF A01.

Progress is reported on a project designed to mesh the molecular approach at the level of basic physical-organic chemistry with chemical engineering for the purpose of gaining deeper and more fundamental insights into available methods of desulfurizing fossil fuels. First, a broad review of hydrodesulfurization processes on an industrial scale was conducted. The progress report itself is divided into three sections: (1) a description of the background and development of the experimental design in catalytic hydrodesulfurization, (2) a discussion of an improved microreactor constructed to carry out kinetics and mechanism experiments directly dealing with desulfurization of sulfur-containing substances present in fossil fuels, and (3) a summary of progress achieved in preliminary experiments together with future projections for research in the area of possible oxidative and thermal desulfurization procedures. Results using dibenzothiophene as a model suggest that an economically feasible process of oxidizing this and other sulfur compounds in residual fuels could be developed.

37464 **Kinetics of oxydesulfurization of Upper Freeport coal.** Slagle, D.; Shah, Y.T.; Joshi, J.B. (Univ of Pittsburgh, Pa). *Ind. Eng. Chem., Process Des. Dev.;* **19**: No. 2, 294-300(Apr 1980).

The kinetics of the oxidation of pyritic sulfur, organic sulfur, and carbon for the Upper Freeport coal are investigated. Experiments were conducted in a semi-batch manner. The effects of batch time (0 to 2400 s), temperature (150 to 210°C), partial pressure of oxygen (0.69 to 3.44 MPa), and total pressure (3.44 to 6.88 MPa) were studied. Two alternate mechanisms have been proposed for the oxidation of pyritic sulfur. In one mechanism the fine pyrite particles are assumed to be uniformly distributed in coal particles and the continuous reaction model was found to hold where the rate of reaction is second order with respect to pyritic sulfur. In the other mechanism, the pyrite particles are assumed to exist free from coal and the shrinking core model was found to hold where the rate of reaction is controlled by diffusion through ash. Both the carbon oxidation and organic sulfur reactions are zero order with respect to carbon and organic sulfur, respectively. 14 refs.

GASIFICATION

REFER ALSO TO CITATION(S) 37511, 37551, 37552, 37554, 37796, 38374, 38376, 38827

37465 (COO—2904-17) **Chemical and physical stability of refractories for use in coal gasification. Final report, May 1, 1976-July 31, 1980.** Fakhr, A.; Lewis, G.L.; Day, D.E. (Missouri Univ., Rolla (USA)). 1 Sep 1980. Contract AS02-76ET10544. 105p. NTIS, PC A06/MF A01.

The dimensional stability, density, porosity, flexural strength and thermal expansion of eighteen cement-bonded, dense and lightweight refractory castables and three phosphate bonded refractories were determined before and after exposure to conditions chosen to simulate those at the cold face (~ 250°C) of a refractory lining in a coal gasification vessel. Chemical reactions occurring in the refractories during exposure were determined by XRD, DTA/TGA and SEM and correlated with the above properties. The variables investigated were: (1) exposure time, 60 days maximum; (2) temperature, up to 538°C; (3) pressure, 6.9 MPa maximum; (4) gas composition, particularly CO/steam ratio (0.1, 1, and 3.0) and presence of 1 vol % H_2S; (5) degree of saturation and (6) liquid versus vapor contact. The degree of saturation of the test atmosphere was the single most important factor affecting the properties after exposure. In dry atmospheres, the properties were close to those for specimens heated to the same temperature in air. In 100% saturated

atmospheres, however, the dense cement bonded castables typically had a flexural strength two to three times higher than that before exposure and a significantly lower porosity. Conversely, the flexural strength of the phosphate bonded refractories was only 1/2 to 1/5 of that before exposure. The exposure time was not particularly important since the chemical reactions occurring during exposure and responsible for the changes in properties, are relatively rapid and appear to be nearing completion within a few days, ≦ 10. All of the refractories were structurally intact after the 60-day maximum exposure to both dry or saturated conditions. The principal chemical reactions in the cement bonded castables were between the cement bond phases and steam, CO, and CO_2.

37466 (DOE/ET/13046—T5) **Industrial fuel gas demonstration plant program. Current working estimate. Phase III and III.** (Memphis Light, Gas and Water Div., TN (USA)). Dec 1979. Contract AC02-77ET13046. 177p. NTIS, PC A09/MF A01.

The United States Department of Energy (DOE) executed a contract with Memphis Light, Gas and Water Division (MLGW) which requires MLGW to perform process analysis, design, procurement, construction, testing, operation, and evaluation of a plant which will demonstrate the feasibility of converting high sulfur bituminous coal to industrial fuel gas with a heating value of 300 +- 30 Btu per standard cubic foot (SCF). The demonstration plant is based on the U-Gas process, and its product gas is to be used in commercial applications in Memphis, Tenn. The contract specifies that the work is to be conducted in three phases. The Phases are: Phase I - Program Development and Conceptual Design; Phase II - Demonstration Plant Final Design, Procurement and Construction; and Phase III - Demonstration Plant Operation. Under Task III of Phase I, a Cost Estimate for the Demonstration Plant was completed as well as estimates for other Phase II and III work. The output of this Estimate is presented in this volume. This Current Working Estimate for Phases II and III is based on the Process and Mechanical Designs presented in the Task II report (second issue) and the 12 volumes of the Task III report. In addition, the capital cost estimate summarized in the appendix has been used in the Economic Analysis (Task III) Report.

37467 (DOE/ET/13046—T6) **Plan for interfacing schedule and test work for pilot plant. Industrial Low-Btu Fuel Gas Demonsration Plant Program.** (Institute of Gas Technology, Chicago, IL (USA)). Jan 1978. Contract AC02-77ET13046. 10p. NTIS, PC A02/MF A01.

This plan outlines the interface arrangements between the two Department of Energy (DOE) programs that require the use of the ash-agglomerating gasifier (AAG) pilot-plant facilities. The two DOE programs are: (1) Operation of the Atmospheric Ash-Agglomerating Gasifier on Coal, Contract No. EX-76-C-01-2336; and (2) Industrial Low-Btu Fuel Gas Demonstration Plant, Contract No. EF-77-C-01-2582. The plan further describes the schedule of operations and test work for the period of time the AAG pilot plant is available for use by the demonstration plant program.

37468 (DOE/ET/13046—T7) **Industrial Fuel Gas Demonstration Plant Program: Bid packages for long-lead items; outline specifications (Deliverable No. 47).** (Memphis Light, Gas and Water Div., TN (USA)). 1979. Contract AC02-77ET13046. 164p. NTIS, PC A08/MF A01.

37469 (DOE/ET/13046—T18) **Plan for obtaining data required for retrofitting burners to industrial fuel gas. Part I. Technical plan for combustion system data (Deliverable No. 44).** (Memphis Light, Gas and Water Div., TN (USA)). 1979. Contract AC02-77ET13046. 48p. NTIS, PC A03/MF A01.

At the outset of Contract No. ET-77-C-01-2582, it was recognized that most but not all natural gas customers could use the product of the Industrial Fuel Gas Demonstration Plant. It was further recognized that, for some of the processes, retrofit information and performance data would have to be developed to make the change possible. Consequently, the program work plan includes Task IX-7, Distribution and Utilization Characteristics of Gas Output. The purposes of this task are: (a) to determine which industrial customers and processes can use the output gas, (b) to identify the required information and performance data necessary for the change, (c) to develop the information and data not available from other sources, and (d) to provide assistance to burner manufactures and current MLGW customers preparing to use the output gas. The total scope of Task IX-7 and the level of effort required are a function of both the type and number of customers. This could not be determined prior to initiation of the contract; consequently, Task IX-7 was proposed as a two-part effort. Under the current contract, a preliminary evaluation of potential MLGW customers and their processes was funded and completed as the first step. This evaluation determined which customers and processes could use the output of the Industrial Fuel Gas Demonstration Plant. It also identified what information and performance data were needed to achieve the changeover.

37470 (DOE/ET/13046—T23) **Memphis Industrial Fuel Gas Demonstration Plant Project. Monthly and quarterly briefing report (Deliverable No. 11 and No. 13).** (Memphis Light, Gas and Water Div., TN (USA)). 14 Nov 1979. Contract AC02-77ET13046. 285p. NTIS, PC A13/MF A01.

37471 (DOE/ET/13046—T59) **Industrial Fuel Gas Demonstration Plant Program. Annual progress report, January-December 1979.** (Memphis Light, Gas and Water Div., TN (USA); Foster Wheeler Energy Corp., Livingston, NJ (USA)). Jan 1980. Contract AC02-77ET13046. 34p. NTIS, PC A03/MF A01.

The objective of the Industrial Fuel Gas Demonstration Plant Program is to demonstrate the feasibility of converting agglomerating and high sulfur coal to clean fuel gas and utilizing this gas in a commercial application. Specific objectives are to conduct process analysis, design, construction, testing, operation and evaluation of a plant based on the U-Gas process for converting coal to industrial fuel gas. Phase I of the MLGW Industrial Fuel Gas Demonstration Plant Program started in September, 1977. In the first quarter of 1978, a conceptual design of a commercial plant was started, together with environmental monitoring activities and technical support work at the U-Gas pilot plant. After a series of successful pilot plant runs during the October 1978-March 1979 period, design work on the Demonstration Plant commenced. With the exception of Task I - Design and Evaluation of Commercial Plant, the majority of all other efforts were completed in 1979. These tasks are listed.

37472 (DOE/ET/13046—T60) **Industrial Low Btu Fuel Gas Demonstration Plant Program: Phase I. Quarterly and annual report, 19 September 1977-31 December 1977.** (Memphis Light, Gas and Water Div., TN (USA); Foster Wheeler Energy Corp., Livingston, NJ (USA)). Jan 1978. Contract AC02-77ET13046. 21p. NTIS, PC A02/MF A01.

A major problem which arose during the reporting period was that of the completion of the required environmental analysis in order not to impact Phase II of the program. This problem was addressed and a proposed solution was agreed to. A sole source procurement justification for Energy Impact Associates was prepared and submitted to DOE for approval. This sole source procurement will enable construction start as scheduled (8 months after start of Phase II) whereas a competitive procurement of this item would have delayed that start by 6 months and with an additional inflationary cost to the program in excess of $5,000,000. The design work on the Commercial Plant is proceeding essentially on schedule. No major problems are foreseen. A major problem to be faced in 1978 is the achievement of successful operating data from the pilot plant necessary to confirm a demonstration plant design. This data must be obtained at a pressure of 3 atmospheres and requires additional modifications to the existing plant as described in IGT's Interface Plan submitted in January.

37473 (DOE/ET/13046—T61) **Industrial Fuel Gas Demonstration Plant Program. Monthly and quarterly progress report, 1 April 1978-30 June 1978 (Deliverable No. 12).** (Memphis Light, Gas and Water Div., TN (USA)). Jul 1978. Contract AC02-77ET13046. 92p. NTIS, PC A05/MF A01.

The design of the commercial plant was completed and a cost estimate prepared. Most work remaining on Task I relates to: Demonstration Plant recommendations and includes a configuration study, at DOE's request, to evaluate alternatives for the Demo Plant Configuration to achieve the required reliability. The specific alternatives being considered are: A base U-Gas Plant designed to produce 50 MMM Btu/day 365 days per year (the High Reliability case); a base U-Gas Plant plus product storage; and a base U-Gas Plant, plus a small methanation facility to upgrade a small portion of the product to obtain credits. Other studies in support of the demonstration plant recommendations include: economic study of U-Gas versus coal-fired boilers for internal steam generation; an assessment of the cost/benefit of designing the Demo Plant for an operating pressure higher than the current data allows; and evaluation of the costs of providing a zero discharge wastewater treatment system.

37474 (DOE/ET/13046—T62) **Industrial Fuel Gas Demonstration Plant Program. Monthly and quarterly progress report, September 1, 1978-September 30, 1978.** (Memphis Light, Gas and Water Div., TN (USA); Foster Wheeler Energy Corp., Livingston, NJ (USA)). Oct 1978. Contract AC02-77ET13046. 63p. NTIS, PC A04/MF A01.

Work during the July-September period was concentrated on the preparation of the Task I report. The Commercial Plant estimate was completed and reviewed by MLGW. A MRC review of the estimate was also conducted. A Plant Configuration study was completed and reviewed by MLGW for enclosure in the Demonstration Plant recommendations. The economic analysis was completed. A preliminary draft of the four volumes of the Task I report was provided to all Industrial Team members and MRC for comments, which were received by the week of September 25th.

37475 (DOE/ET/13046—T71) **Industrial Fuel Gas Demonstration Plant Program. Monthly, quarterly and annual progress report, December 1978 and Calender Year 1978.** (Memphis Light, Gas and Water Div., TN (USA); Foster Wheeler Energy Corp., Livingston, NJ (USA)). 1978. Contract AC02-77ET13046. 98p. NTIS, PC A05/MF A01.

A new pilot plant program developed by DOE and the team members, was started on September 20, 1978. Pilot plant success was achieved in obtaining an ash balanced condition for several days with ash agglomeration with a pure coal feed. This was the objective of the first three months of the approved program.

37476 (DOE/ET/14809—3) **Investigation of sulfur-tolerant catalysts for selective synthesis of hydrocarbon liquids from coal-derived gases. Quarterly technical progress report, March 19-June 18, 1980.** Bartholomew, C.H. (Brigham Young Univ., Provo, UT (USA)). 10 Jul 1980. Contract AC01-79ET14809. 26p. NTIS, PC A03/MF A01.

A 15% Fe-3% K_2O on SiO_2 catalyst, a 15% Co-3% K_2O on SiO catalyst and a 15% CoB/SiO_2 catalyst were prepared. H_2 and CO chemisorption uptakes were measured for the catalysts prepared to date. It was noted that calcining the iron catalysts in air before reduction in flowing H_2 aided in increasing metal dispersion. Liquid and wax traps for use in the reactor system were completed as were plans for chromatographic product analysis.

37477 (DOE/FE—0002/79/3) **Coal gasification. Quarterly report, July-September 1979.** (Department of Energy, Washington, DC (USA). Div. of Coal Conversion). Jul 1980. 63p. NTIS, PC A04/MF A01.

The status of 18 coal gasification pilot plants or supporting projects supported by US DOE is reviewed under the following headings: company involved, location, contract number, funding, gasification process, history, process description, flowsheet and progress in the July-September 1979 quarter. (LTN)

37478 (DOE/FE—0004/79/3) **Coal demonstration plants. Quarterly report, July-September 1979.** (Department of Energy, Washington, DC (USA). Div. of Coal Conversion). Jul 1980. 63p. NTIS, PC A04/MF A01.

The status of two coal liquefaction demonstration plants and of four coal gasification demonstration plants is reviewed under the following headings: company involved, contract number, funding, process name, process description, flowsheet, schedule, history and progress during the July-September quarter, 1979. Supporting projects in coal feeding systems, valves, grinding equipment, instrumentation, process control and water treatment are discussed in a similar way. Conceptual design work on commercial plants for coal to methanol and for a HYGAS high BTU gas plant were continued. (LTN)

37479 (EGG-FM—5225) **Effect of four simulated coal gasifier atmospheres on the biaxial stress rupture behavior of four candidate coal gasifier alloys.** Horton, R M. (Idaho National Engineering Lab., Idaho Falls (USA)). 22 Aug 1980. Contract AC07-76ID01570. 34p. NTIS, PC A03/MF A01.

Tests were conducted on four alloys (Type 310 stainless steel, Incoloy 800H, Haynes 188, and IN-657) which are candidates for use in coal gasifiers to determine whether their hundred-hour biaxial stress rupture strength and life were adversely affected by exposure to four simulated coal gasifier atmospheres (CGA). Exposure to these atmospheres at temperatures below 1172°K did not decrease these rupture properties below those measured in air. Only at 1255°K were the rupture properties in the various CGA atmospheres consistently below those measured in air at atmospheric pressure.

37480 (FE—1793-64) **Design, fabricate and test a complete laboratory scale coal feeder injector system. Phase III. Final report, 30 April 1980.** Harding, J.C.; Hannoosh, J.; Chandrasekhar, R. (Foster-Miller Associates, Inc., Waltham, MA (USA)). Aug 1980. Contract AC01-76ET10266. 62p. NTIS, PC A04/MF A01.

This report summarizes the results of the Phase III of the Coal Feeder Development Program carried out by Foster-Miller Associates, Inc., for the US Department of Energy. During Phase III development was continued on two feeder concepts which had demonstrated the most promise in Phase II. These included: the Linear Pocket Feeder (LPF) and the Centrifugal Feeder. As a part of the feeder development work, a new feeder test facility was developed with seven times the capacity of the test facilities used in the previous phase. The LPF prototype was subjected to a continuing cycle of test, evaluation, redesign, and retest. Total feeder operating time reached 345 h. Solutions to all reliability problems identified to date have been developed. Development of a second generation pilot scale prototype is recommended. The 200 lb/in² centrifugal feeder developed in Phase II was modified and used to develop design data for a second generation centrifugal feeder prototype. This prototype was designed to operate at backpressures to 500 psig and feed rates of 3 to 5 tons/h. Testing of the feeder was terminated after 6 weeks to conserve funds for the LPF development work. The 500 lb/in² feeder prototype represents a substantial advance over the very successful 200 lb/in² prototype, with 300 available horsepower (versus 40 hp for the older unit). All feeder and test components have been designed for operation to 1000 psig to facilitate development beyond the 500 psig goal. Continued development of this promising concept is recommended.

37481 (FE—2247-26) **Gasification of residual materials from coal liquefaction. Type IV Sustained Pilot Plant evaluation of SRC-II vacuum flash drum bottoms from Powhatan coal.** Robin, A.M.; Catena, A.R.; Nour, E. (Texaco, Inc., Montebello, CA (USA). Montebello Research Lab.). Jul 1980. Contract AC01-76ET10137. 99p. NTIS, PC A05/MF A01.

A Type IV Sustained Pilot Plant demonstration of SRC-II vacuum flash drum bottoms obtained from the liquefaction of Powhatan coal at Ft. Lewis, Washington was successfully completed at Texaco's Montebello Research Laboratory. Approximately 83 tons of SRC-II residue were gasified during four pilot plant runs at 1200 and 600 psig. The longest continuous run was 127 hours, and a total of 237 hours of operation was accumulated. Operating conditions were held substantially constant throughout the demonstrations. The dry syngas produced contained over 90 (vol) percent hydrogen plus carbon monoxide. No major operating problems were experienced and all of the key phases of the gasification were demonstrated. Steady state operating conditions were obtained in all streams, and extensive environmental data were obtained.

37482 (LA—8493-MS) **BICYCLE: a computer code for calculating levelized life-cycle costs.** Hardie, R.W. (Los Alamos Scientific Lab., NM (USA)). Aug 1980. Contract W-7405-ENG-36. 38p. NTIS, PC A03/MF A01.

This report serves as a user's manual for the BICYCLE computer code. BICYCLE was specifically designed to calculate levelized life-cycle costs for plants that produce electricity, heat, gaseous fuels, or liquid fuels. Included in this report are (1) derivations of the equations used by BICYCLE, (2) input instructions, (3) sample case input, and (4) sample case output.

37483 (UCID—18801) **Introduction to underground coal gasification.** Stephens, D.R. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). Aug 1980. Contract W-7405-ENG-48. 30p. NTIS, PC A03/MF A01.

Underground coal gasification (UCG) offers a relatively low cost, environmentally sound method to produce clean fuels from coal. Underground coal gasification can provide pipeline quality gas and premium gasoline from deep, unusable coal. Underground coal gasification is similar to conventional coal gasification except that the coal is not mined - gasification takes place underground. Steam and oxygen are injected underground, reacting the coal to produce a medium heating value gas which can be converted into pipeline quality gas and premium gasoline in surface facilities. Projected costs are comparable to or lower than that of conventional coal gasification systems. There are environmental advantages. There is a UCG resource in the US which would last for hundreds of years. If the R and D is successful, commercial production could begin in ten years or less.

37484 (FE—2012/Z/80/06(Vol.3)(Bk.2)) **Pipeline gas demonstration plant: Phase I, abbreviated version of conceptual commercial plant design. Volume 3. Book 2: Section 4, detailed area concept and descriptions (plant areas 113 through 120.** Eby, R.J. (Illinois Coal Gasification Group, Chicago (USA)). Jul 1980. Contract AC01-77ET13031. 303p. NTIS, PC A14/MF A01.

This section describes the 20 plant areas that make up the ICGG Conceptual Commercial Plant. Process flows, descriptions, design basis, equipment specifications, utility requirements, etc., are provided for plant area.

37485 (FE—2012/Z/80/06(Vol.3)(Bk.1)) **Pipeline gas demonstration plant: Phase I, abbreviated version of conceptual commercial plant design. Volume 3. Book 1: Section 4, detailed area concept and descriptions (plant areas 101 through 112).** Eby, R.J. (Illinois Coal Gasification Group, Chicago (USA)). Jul 1980. Contract AC01-77ET13031. 288p. NTIS, PC A13/MF A01.

This section describes the 20 plant areas that make up the ICGG Conceptual Commercial Plant. Process flows, descriptions, design basis, equipment specifications, utility requirements, etc., are provided for each plant area.

37486 (FE—2012/Z/80/06(Vol.2)) **Pipeline gas demonstration plant: Phase I, abbreviated version of conceptual commercial plant design. Volume 2. Section 3, environmental considerations.** Eby, R.J. (Illinois Coal Gasification Group, Chicago (USA)). Jul 1980. Contract AC01-77ET13031. 333p. NTIS, PC A14/MF A01.

A specific site for the Commercial Plant has not been selected. However, it is anticipated that this site will be in the immediate vicinity of the site proposed for the Demonstration Plant. Since considerable data regarding this site has been gathered in this per-

formance of Task III, site evaluation and selection, and Task IV, Demonstration Plant Environmental Analysis, this information has been used when appropriate in order to provide as realistic an evaluation of environmental effects as possible. This section discusses the present environmental characteristics of the site and the surrounding area that might be affected by the construction and operation of the Commercial plant. It discusses expected effects of site preparation, construction and operation of the Plant and its ancillaries, in terms of its impact on the physical, biological, and human environments. In the discussion of environmental effects, effects that are considered temporary or subject to amelioration are clearly distinguished from those regarded as unavoidable and irreversible. Means selected to minimize environmental impacts are outlined. Elements of workplace safety are identified together with safety measures and steps to minimize accident occurrence. Preoperational and operational monitoring programs are identified. A summary analysis of the benefits and costs of constructing and operating the Commercial Plant is presented. Benefits are summarized in terms of dollar earnings and positive impacts on the regional economy and populations. Costs are summarized as direct costs of construction and operation, and as indirect economic, social and environmental costs.

37487 (FE—2012/Z/80/06(Vol.1)) **Pipeline gas demonstration plant: Phase I, abbreviated version of conceptual commercial plant design. Volume 1. Section 1, executive summary; Section 2, commercial plant description.** Eby, R.J. (Illinois Coal Gasification Group, Chicago (USA)). Jul 1980. Contract AC01-77ET13031. 230p. NTIS, PC A10/MF A01.

The comprehensive analyses and studies in conjunction with the successful implementation of the Technical Support Plan have confirmed that: The COGAS Process is ready for demonstration. The technical risk is inherently low and there is a high probability of operating feasibility and economic viability for the Commercial Plant. The use of commercially proven process technology and commercially available components has been maximized to reduce technical risk. The integration of multiple processes is technically feasible and desirable resulting in a high thermal yeild. The process is safe, reliable and environmentally acceptable. The plant is inherently flexible having a high turndown ratio. The design changes required in order to process various coal types have been identified and are achievable.

37488 (FE—2012/Z/80/06(Vol.1)(Suppl.)) **Pipeline Gas Demonstration Plant: Phase I, abbreviated version of conceptual commercial plant design. Volume I. Supplement: Section 1, executive summary and Section 2, commercial plant description.** Eby, R.J. (Illinois Coal Gasification Group, Chicago (USA)). Jul 1980. Contract AC01-77ET13031. 24p. NTIS, PC 02/MF A01.

37489 (FE—2012/Z/80/06(Vol.3)(Bk.1)(Suppl.)) **Pipeline Gas Demonstration Plant: Phase I, abbreviated version of conceptual commercial plant design. Volume 3. Book 1: supplement, Section 4, detailed area concept and descriptions (plant areas 101 through 112).** Eby, R.J. (Illinois Coal Gasification Group, Chicago (USA)). Jul 1980. Contract AC01-77ET13031. 59p. NTIS, PC A04/MF A01.

37490 (FE—2012/Z/80/06(Vol.3)(Bk.2)(Suppl.)) **Pipeline Gas Demonstration Plant: Phase I, abbreviated version of conceptual commercial plant design. Volume 3. Book 2: supplement, Section 4, detailed area concept and descriptions (plant areas 113 through 120).** Eby, R.J. (Illinois Coal Gasification Group, Chicago (USA)). Jul 1980. Contract AC01-77ET13031. 105p. NTIS, PC A06/MF A01.

37491 (FE—2012/Z/80/06(Vol.4)) **Pipeline gas demonstration plant: Phase I, abbreviated version of conceptual commercial plant design. Volume 4. Section 5, plant operating concept; Section 6, products and byproducts; Section 7, economic assessment.** Eby, R.J. (Illinois Coal Gasification Group, Chicago (USA)). Jul 1980. Contract AC01-77ET13031. 219p. NTIS, PC A10/MF A01.

This volume contains sections 5, 6, and 7. Section 5 provides a description of the plant personnel and plant operations, an outline of start up and shutdown procedures, and a brief description of plant shakedown, system testing, maintenance, safety and laboratory support. Section 6 describes the products and byproducts which will be produced by the Commercial Plant and discusses their marketability. Section 7 presents an economic assessment of the Conceptual Commercial Plant including estimated capital requirements, operating costs, a discounted cash flow analysis to determine the required gas selling price, and an analysis of the sensitivity of the gas selling price to various economic factors.

37492 Electrochemical gasification of coal--simultaneous production of hydrogen and carbon dioxide by a single reaction involving coal, water, and electrons. Coughlin, R.W.; Farooque, M. (Univ of Conn, Storrs). *Ind. Eng. Chem., Process Des. Dev.;* **19**: No. 2, 211-219(Apr 1980).

Coals and other forms of solid carbonaceous fossil fuel are oxidized to oxides of carbon at the anode of an electrochemical cell and hydrogen is produced at the cathode. These gases are thereby produced in relatively pure states. The reaction proceeds at very mild temperatures and at operating electrical potentials lower than 1 V, i.e., significantly lower than the thermodynamic potential of water electrolysis. The process may be viewed as driven simultaneously by energy supplied at low temperatures in approximately equal proportions by the coal and by an external electrical source. It is expected that coal can supply a larger proportion of the energy if the process is operated at higher temperature for which the required electrical potential will be lower. 22 refs.

37493 Simulation of coal conversion reactor environments. Cooke, R.A.; Devereux, O.F. *Corrosion;* **36**: No. 4, 167-173(Apr 1980).

Recent emphasis on the gasification and liquification of coal to produce clean fuels has stimulated considerable study of the behavior of structural metals and alloys in the coal conversion reactor environment. This environment is especially aggressive because of the presence of oxidants other than oxygen. In this work, two models simulating the coal gasifier environment are described; Model 1 comprises coal gas components and a molten sodium salt phase, while Model 2 also includes a solid carbon phase. The use of equilibrium constants to compute the equilibrium state of an open system and the occurrence of multiple equilibrium states are detailed. 18 refs.

LIQUEFACTION

REFER ALSO TO CITATION(S) 37476, 37478, 37481, 37482, 37493, 37504, 37551, 37552, 38349, 38374

37494 (CONF-800610—10(Draft)) **Rheological characterization of coal-solvent slurry at high temperature and pressure.** Oswald, G.E.; Youngblood, E.L.; Thurgood, J.R. (Utah Power and Light Co., Salt Lake City (USA); Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 18p. NTIS, PC A02/MF A01.

From American Institute of Chemical Engineering conference; Philadelphia, PA, USA (8 Jun 1980).

During the preheating operation in coal-solvent slurry dissolution liquefaction processes, the slurry exhibits pseudoplastic non-Newtonian flow behavior as well as a viscosity maximum when the heated coal becomes plastic. Rheological characterizations were made on 35 weight percent coal-solvent slurry at up to 700K (800°F) at 13.9 MPa (200 psig) in a continuous flow bench-scale system. The system consists of high pressure slurry and hydrogen delivery systems, preheater, reactor/dissolver, vapor-liquid separator, and pressure control and slurry pressure letdown systems. For rheological characterization, preheated slurry was passed, at temperature and pressure, through a capillary or pipeline viscometer located at the preheater discharge. Preheater residence time and discharge temperature can be varied. Rheograms (shear stress vs shear rate plots) are presented for slurry at temperatures and pressures representative of the preheating operation, and the method of analysis is discussed.

37495 (DOE/ET/10149—T3) **Holdup correlations in slurry-solid fluidized beds.** Vasalos, I.A.; Rundell, D.N.; Megiris, K.E.; Tjatjopoulos, G.J. (Amoco Research Center, Naperville, IL (USA); Thessaloniki Univ. (Greece). Dept. of Chemical Engineering). 1980. Contract AC05-77ET10149. 13p. NTIS, PC A02/MF A01.

The use of slurry-solids fluid beds plays an important role in the development of synthetic fuels and the hydrogen processing of petroleum resids. In the H-Coal process in particular, coal oil slurries are processed over extrudates of hydrodesulfurization catalyst. The objective of this note is to present a model which describes the volume fraction occupied by the slurry phase. The accurate prediction of the liquid holdup is important not only for the calculation of the bed height in liquid solid fluidized beds, but also is required for the development of a model predicting the holdup in three-phase fluidized beds. In the present publication, the application of two different correlations is considered: (1) the Richardson and Zaki; and (2) Ramamurthy and Sabbaraju.

37496 (DOE/FE—0003/79/3) **Coal liquefaction. Quarterly report, July-September 1979.** (Department of Energy, Washington, DC (USA). Div. of Coal Conversion). Jul 1980. 65p. NTIS, PC A04/MF A01.

The status of coal liquefaction pilot plants supported by US DOE is reviewed under the following headings: company involved, location, contract, funding, process name, process description, flowsheet, history and progress during the July-September 1979 quarter. Supporting projects such as test facilities, refining and upgrading coal liquids, catalyst development, and gasification of residues from coal gasification plants are discussed similarly. (LTN)

37497 (DOE/FE/10490—01) **Achieving a production goal of 1 million B/D of coal liquids by 1990.** (TRW Energy Systems Planning Div., McLean, VA (USA); Bechtel National, Inc., San Francisco, CA (USA); Mechanical Technology, Inc., Latham, NY (USA);

UOP, Inc., McLean, VA (USA); System Development Corp., McLean, VA (USA); Monsanto Research Corp., Miamisburg, OH (USA)). Mar 1980. Contract AC01-77ET10490. 637p. NTIS, PC A99/MF A01.

Under this contract, Bechtel analyzed the resource requirements and reviewed major obstacles to the daily production of several million barrels of synthetic coal liquids. Further, the study sought to identify the industry infrastructure needed to support the commercial readiness of the coal liquefaction process. A selected list of critical resource items and their domestic/international availability was developed and examined, and the impact of their supply on the various synthetic coal liquids programs was evaluated. The study approach was to develop representative, or generic, direct and indirect coal liquefaction conceptual designs from available technology and costs data. The generic processes were to employ technology that would be considered commercial by the mid- or late-1980s. The size of the generic construction mobilization was considered reasonable at the outset of the program. The product slate was directed toward unrefined liquid fuels rather than diesel oil or gasoline. The generic processes were to use a wide range of coals to permit siting in most coal-producing regions across the country. Because of the dearth of conceptual design data in the literature, Bechtel developed generic plant designs by using in-house design expertise. Bechtel assumed that because it is first generation technology, the indirect process will be used at the outset of the liquids program, and the direct process will be introduced two to four years later as a second generation technology. The products of either of these processes will be limited to boiler fuels and/or other liquid products which require further upgrading. Cost estimates were developed from equipment lists, as well as material and labor estimates, which enabled the determination of an order-of-magnitude cost estimate and target plant construction schedule for both processes.

37498 (FE—2034-20) **Catalytic hydrogenation of coal-derived liquids. Interim report, June 1980-August 1980.** Berg, L.; McCandless, F.P. (Montana State Univ., Bozeman (USA). Dept. of Chemical Engineering). Sep 1980. Contract AC01-76ET10495. 44p. NTIS, PC A03/MF A01.

The objective of this research is to convert coal to clean distillate fuels. This program will be limited to research on the product of PAMCO's solvent refined coal (SRC-II). The SRC will be heated and pumped, with and without solvent, into a catalytic reactor in the presence of hydrogen and other reducing gases. Variables to be investigated will include temperature, pressure, space velocity, hydrogen-to-oil ratio and chemical nature of the solvent. The catalysts to be studied will include nickel molybdate and sulfide, nickel tungstate and other combinations on carriers such as mordanites and other molecular sieve types. Sixteen catalysts comprising each possible four metal combination of 2 and 4% CoO, 2 and 8% MoO_3, 1 and 4% NiO and 2 and 8% WO_3 were fabricated on the same base material, tested with SRC-II and the results analysed statistically. All of these catalysts gave specification denitrogenation, only a change in the concentration of CoO had a small but significant effect. Analyses of products were completed on the evaluation of the nonpromoted base material as well as the T.C.C. cracking catalyst. They confirmed the conclusion stated in our previous report that these catalysts are incapable of effecting sufficient denitrogenation to meet our goals.

37499 **Coal liquefaction.** Hazlett, R.N. US Patent 4, 176,040. 27 Nov 1979. Filed date 8 May 1978. 4p.

This patent discloses a method for converting coal to liquid hydrocarbons or oil-soluble solids comprises the steps of contacting said coal with oxygen for at least 15 minutes, at a temperature from about 90 to about 225 C., heating the oxidized coal to a temperature from about 250 to about 450 C., and maintaining the temperature for at least 15 minutes. (Author)

37500 (TE—7905-272-80) **Economic and technological assessment of diesel engines using coal-based fuels for electric power generation. Quarterly progress report, first quarter 1978.** Dunlay, J.B. (Thermo Electron Corp., Waltham, MA (USA)). 1978. Contract AC01-77ET10347. 22p. NTIS, PC A02/MF A01.

The test plan for the first fuel test (COED) was prepared. The research engine is a one-cylinder version of the Sulzer large bore engine design. To provide flexibility in testing, a two-stage air blower (externally powered) is used in place of the standard turbocharger to establish the required inlet air conditions to the engine. Orifice plates are used in the engine exhaust to simulate the normal back pressure of the turbocharger. Test data include specific fuel and air consumption, exhaust gas temperature and pressure, cylinder temperature and pressure, scavenging air temperature and pressure, fuel injection system pressure and valve opening, and exhaust emissions. Analyses of the data, specifically the cylinder pressure indicator diagrams, provide measured values of ignition delay, second and third stage combustion times, and indications of the time required for complete combustion. The test plan is shown in the Appendix. Fuel for the second research engine test was shipped to Sulzer in January. This fuel is liquid SRC-II, a middle distillate with a boiling range of 365° to 562°F. The kinematic viscosity at 100°F is approximately 3.1 centistokes, which is less than that of the COED fuel provided for the first engine test. Handling characteristics of the SRC-II should be comparable to those of a light distillate.

37501 (TE—7905-271-80) **Economic and technological assessment of diesel engines using coal-based fuels for electric power generation. Quarterly progress report, fourth quarter 1977.** Dunlay, J.B. (Thermo Electron Corp., Waltham, MA (USA)). [nd]. Contract AC01-77ET10347. 12p. NTIS, PC A02/MF A01.

Two coal-derived liquid fuels, COED and SRC-II, and a micronized coal/oil slurry were selected for testing in the Sulzer single-cylinder research engine. This selection was based on the availability of the fuels and the desire to explore engine performance on fuels exhibiting significantly different properties. COED is an early development in coal-derived liquid fuels and is available in limited quantities from storage. This fuel exhibits a relatively high hydrogen content and engine performance should be similar to petroleum fuels. SRC-II is currently under development and is considered a typical coal-derived liquid that may be produced commercially in the future. SRC-II has a lower hydrogen content than COED and probably will require some adjustment in engine conditions to achieve satisfactory ignition. The micronized coal/oil slurry was developed by Pittsburgh Energy Research Center and represents a promising means of using coal directly as a diesel engine fuel. The engine tests will be performed in the Sulzer single-cylinder research engine located in Winterthur, Switzerland. The first series of tests will be run with COED. Fifty drums of COED have been shipped to Sulzer in preparation for these tests.

PYROLYSIS AND CRACKING

37502 (ORNL/MIT—294) **Coal block pyrolysis: effects of changing surface characteristics.** Alexander, G.L.; Hu, B.V.; Kwai, A.H. (Oak Ridge National Lab., TN (USA)). Oct 1980. Contract W-7405-ENG-26. 31p. NTIS, PC A03/MF A01.

A microgravimetric balance was used to study the surface characteristics of char from the block pyrolysis of wet and dry Texas lignite under argon and hydrogen. Nitrogen, carbon dioxide, and water isotherms with corresponding Brunauer-Emmett-Teller (BET) surface areas and Dubinin-Radushkevich-Kaganer (DRK) micropore volumes were obtained. The water isotherm showed the existence of hydrophilic and hydrophobic sites not apparent from N_2 and CO_2 isotherms. Char characteristics were related to pyrophoricity, with loss of microporosity and pyrophoricity observed for chars produced under hydrogen but not under argon sweep gas.

PROPERTIES

REFER ALSO TO CITATION(S) 37494, 37547, 37585, 37630, 38081, 38349, 38470

37503 (BNL—28342) **Study of coal oxidation by charged particle activation analysis.** Schlyer, D.J.; Wolf, A.P. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 15p. (CONF-801125—1). NTIS, PC A02/MF A01.

From 12. central regional meeting of the American Chemical Society; Pittsburgh, PA, USA (12 Nov 1980).

The technique of Charged Particle Activation Analysis (CPAA) was applied to study the characteristics of low temperature oxidation of coal. The following parameters were investigated: the kinetics of the adsorption of oxygen containing species; the elemental composition of the oxide layer and how deeply it extends into the particle; and the number of reactive sites on or in the surface. The results of this study are in agreement with those of other laboratories. These are summarized as follows: adsorption of oxygen onto most types of coal follow Elovich kinetics, i.e., a rapid uptake followed by a much more gradual uptake; oxygen adsorbed by low rank coals can form phenolic-OH or carbonyl groups; water sorption isotherms on low rank roals have a standard type II sigmoid shape typical of porous adsorbents; heat of desorption for macroscopic amounts of water off most coals is very near that of the heat of vaporization of water; and the apparent activation energies for oxidation are very low. From the data collected a mechanism for low temperature oxidation was proposed.

37504 (CONF-800602—9(Draft)) **Measurement of physical properties of coal liquids under process conditions.** Oswald, G.E.; Youngblood, E.L.; Hightower, J.R.; Cochran, H.D. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 9p. NTIS, PC A02/MF A01.

From Symposium on instrumentation and control for fossil energy processes; Virginia Beach, VA, USA (9 Jun 1980).

Instrumentation has been developed for measurement of physical properties (viscosity and density) of coal liquids and slurries

under conditions typical of those found in coal liquefaction processes such as SRC, H-Coal, and EDS. The instruments are being operated in a flow system designed for slurry rates up to 1 g/s at 810 K and 31 MPa pressure. A capillary tube viscometer and a Norcross falling ring viscometer are used for viscosity measurement. Thus far rheograms (shear rate vs shear stress diagrams) have been determined for 35 wt % Illinois No. 6 coal (-170 mesh) in SRC-I recycle solvent at 13.9 MPa (2000 psig) for the temperature range of 400 to 700 K. A commercially available gamma radiation absorption instrument has been modified for the operating conditions required and is being used for density measurements. Instruments for measurement of thermal conductivity and heat capacity of coal liquids have been designed for future installation in the facility.

37505 (DOE/ET/11426—T1) **Small-angle x-ray scattering studies of the porosity of coals and chars. Quarterly progress report, July 1-September 30, 1980.** Schmidt, P.W. (Missouri Univ., Columbia (USA). Dept. of Physics). Sep 1980. Contract AS01-78ET11426. 30p. NTIS, PC A03/MF A01.

Considerable effort has been devoted to checking and verifying some of the preliminary data reported previously. The technique employed in the past for measuring the x-ray transmission of the samples has been modified to provide more accurate values of the transmission. These transmission measurements are important for quantitative interpretation of the scattering data both because they are needed to determine the amount of background scattering that must be subtracted from a measured scattering curve and also because the value of the transmission is required for calculating the specific surface from the scattering data. Previous determinations of the specific surface have been checked and modified when corrected transmission values made recalculation necessary. Evaluation of the specific surface from the scattering data also requires a measurement of the absolute scattered intensity, or scattering cross section. In other words, the fraction of the incident radiation which is scattered must be known. For this scattering investigation of coals, the absolute intensity for the scattering system was determined by measurement of the scattering from a colloidal silica suspension. The details of this technique are described by I.S. Patel and P.W. Schmidt, J. Appl. Cryst. 4, 50 to 55. (1971).

37506 (DOE/PMTC/TR—1(80)) **Evaluation of an optical microscope method for coal-pyrite/marcasite differentiation.** Sanner, W.S. Jr.; Meteney, D.L. (Department of Energy, Pittsburgh, PA (USA). Pittsburgh Mining Technology Center). May 1980. 13p. NTIS, PC A02/MF A01.

A reflected-polarized light microscope technique for coal marcasite-pyrite differentiation is detailed. Presence of the two minerals was verified by x-ray diffraction analysis. The optical technique produced marcasite content values that were consistently lower than those measured by x-ray diffraction. Although the optical technique produces data that are at best semi-quantitative, it can be used to approximate (+-20%) marcasite concentration in coal without a heavy mineral concentration step.

37507 (EPRI-CS—989(Vol.2)) **Nuclear assay of coal. Volume 2. Coal composition determination by prompt neutron activation analysis: theoretical modeling. Final report.** Elias, E.; Gozani, T. (Science Applications, Inc., Palo Alto, CA (USA)). Apr 1980. 44p. NTIS, PC A03/MF A01.

Simplified one-dimensional models based on the ANISN and CAPGAM computer codes were used to calculate neutron-gamma transport in coal. These calculations were applied to the study of effects of various parameters on the measured capture gamma signals from coal samples and to the design and evaluation of prompt neutron activation analysis (PNAA) experiments. Dependence of capture gamma-ray intensity on bulk density, sample thickness, and coal composition and geometry was determined. The calculated gamma signal for a 30-cm (11.8 in)-thick sample was almost independent of the sample's density variation and bulk density. A reflected neutron source outside a slab sample was calculated to yield ~ 80% of the gamma intensity of a geometry where the source is embedded in the coal (bin geometry). Hydrogen, nitrogen, sulfur, and iron had the strongest effect on thermal neutron absorption and gamma-ray production. Methods of corrections and normalization are discussed.

37508 **Fluorescence line narrowing spectrometry in glasses for direct determination of polycyclic aromatic hydrocarbons in solvent-refined coal.** Brown, J.C.; Duncanson, J.A. Jr., Small, G.J. (Iowa State Univ., Ames). Contract W-7405-ENG-82. *Anal. Chem.;* **52**: No. 11, 1711-1715(Sep 1980).

Instrumentation for fluorescence line narrowing spectrometry (FLNS) in glasses is described. Results presented include standard FLN spectra for several polycyclic aromatic hydrocarbons (PAHs). It is shown that FLNS in glasses can afford detection limits of ~ 1 part per trillion (pptr) for strongly fluorescent species, distinguish between substitutional isomers, and be used for the analysis of complex mixtures of PAHs. The selectivity provided by FLN, selective excitation and time resolution, is utilized for the direct determination of PAHs in a solvent-refined coal sample. The potential of the technique for the direct determination of fluorescent species in water is discussed.

37509 **Characterization of coal tar pitch oils by nuclear magnetic resonance.** Schultz, H.D. (Energy Research and Development Administration, Morgantown, WV); Smith, R.R. *Spectrosc. Lett.;* **12**: No. 6, 467-533(1979).

Nuclear Magnetic Resonance (NMR) spectrometry has been used to characterize coal tar pitch oils, which had been obtained from a low-temperature carbonization of high volatile bituminous coal. NMR provides data on hydrogen distribution in coal oils and structural correlations established on elution chromatographic, on distillation fractions, and on the residues remaining after distillation. This research is the first report on the hydrogen distribution of coal tar pitch oils by NMR.

37510 **Oxidative degradation studies of coal and solvent-refined coal.** Hayatsu, R.; Winans, R.E.; Scott, R.G.; Moore, L.P.; Studier, M.H. (Argonne National Lab., IL). *ACS Symp. Ser.;* No. 71, 108-125(1978).

Aqueous sodium dichromate has been found to be a selective oxidant and numerous polyaromatic units, which resulted from the oxidation of a bituminous coal, have been reported. These products are believed to be indigenous to the coal. The effects of other oxidizing agents have been explored. Four coals and a solvent-refined coal have been subjected to oxidative degradation. Two completely abiotic samples, a synthetic Fischer-Tropsch polymer, and a polymer from the Murchison meteorite were used for comparison and to test the oxidation methods. In general, the oxidation products were carboxylic acids which were esterified by diazomethane to increase their volatility for mass spectrometry. Oxidants used were nitric acid, hydrogen peroxide, acetic acid, photochemical oxidants, and sodium hypochlorite. 4 figures, 4 tables.

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 37590, 38082, 38083, 38085, 38094, 38095, 38096, 38299, 38303, 38709, 38878

37511 (CONF-800608—4) **Disposal characteristics of solid residues from coal gasification.** Boegly, W.J. Jr.; Davis, E.C.; Wilson, H.W. Jr. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 21p. NTIS, PC A02/MF A01.

From Air Pollution Control Association annual meeting; Montreal, Canada (Jun 1980).

It can be seen that the initial leaches from the gasifier ashes tested may represent a potential problem for certain of the parameters listed in the secondary drinking water standards (Cu, Zn, Fe, Mn, SO_4, and TDS). Landfills for these wastes must be located in soils having satisfactory attenuation properties for these materials, or some dilution of these leachates must occur if they are not to violate groundwater criteria for use as public water supplies. If neither of these can be guaranteed at the disposal site, some form of liner will be required. Currently, soil attenuation characteristics of the demonstration plant disposal sites are being evaluated, and this data will be used in larger soil/ash columns to develop models for use in predicting trace element migration from the landfills.

37512 (DOE/ET/10415—45) **Development of potential uses for the residue from fluidized bed combustion processes. Quarterly technical progress report, June-August 1980.** Minnick, L.J. (Minnick (L.J.), Inc., Plymouth Meeting, PA (USA)). 1980. Contract AC21-77ET10415. 25p. NTIS, PC A02/MF A01.

The following conclusions are recorded: The road base mixes in which quartz silica was substituted for the pulverized coal fly ash gave compressive strengths similar to those using the pulverized coal fly ash. The compressive strengths of road base mixes using recently produced AFB residue were of the same order of magnitude as those obtained in 1977, although the data covers a broad range of test results. Briquettes, produced from a number of trial mixes, show promise as a synthetic aggregate. Expansive grout mixes of slurry consistency achieve satisfactory compressive strengths in seven days. Sections of the test strips in Canton, Ohio show minimal expansion.

37513 (EPA—600/7-79-167a) **Proceedings: symposium on flue gas desulfurization.** Ayer, F.A. (comp.). (Research Triangle Inst., Research Triangle Park, NC (USA)). Jul 1979. 635p. (CONF-790371—(Vol.1)). NTIS.

From 5. flue gas desulfurization symposium; Las Vegas, NV, USA (5 Mar 1979).

This publication, in two volumes, contains the text of all papers presented at EPA's fifth flue gas desulfurization (FGD) symposium, March 5-8, 1979, at Las Vegas, Nevada. Papers cover such subjects as health effects of sulfur oxides, impact of FGD on the economy and the energy problem, energy and economics of FGD processes, actual operating experience, waste disposal and

byproduct marketing, and industrial boiler applications. Nineteen papers from volume 1 have been entered individually into EDB and ERA. (LTN)

37514 (EPA—600/7-79-167a, pp 14-20) **Remarks: by general manager, Tennessee Valley Authority, before symposium on flue gas desulfurization.** Ring, L. (Tennessee Valley Authority, Knoxville). Jul 1979.

From 5. flue gas desulfurization symposium; Las Vegas, NV, USA (5 Mar 1979).

In the 1960s and early 1970s TVA went about the business of protecting the environment by a variety of methods. We built tall stacks as much as 1000 feet high to disperse pollutants; we installed electrostatic precipitators to control fly ash; emissions were limited by operational procedures. Selective use of clean fuels and selective installation of SO_2 removal systems were practiced or planned. A master plan that would enable TVA to meet ambient sulfur dioxide and particulate emission standards at all of its plants was proposed in 1973. This plan included the use of tall stacks at three plants; intermittent controls at nine plants; and an experimental SO_2 scrubber at the Widows Creek plant. TVA felt that ambient sulfur dioxide standards fully protected the public welfare from any known or anticipated effect of sulfur dioxide. And there was doubt that continuous SO_2 emission standards were necessary to meet the requirements of the 1970 Clean Air Act for existing installations. Using these methods, TVA could have met ambient standards at about one-tenth the cost of utilizing either scrubbers or low-sulfur coal. This TVA approach differed significantly from what EPA proposed. This difference revolved around interpretation of what was required under the Clean Air Act and was finally settled by the Supreme Court in 1976 when they refused to hear our case. This decision necessitated the use of continuous emission control and TVA moved into a new era of sulfur dioxide emission control. The agreement calls for the use of low- and medium-sulfur coal, coal washing, and more scrubbers, and will bring all TVA plants into full compilance with requirements of the Clean Air Act. Carrying out the settlement will not be without problems. The massive amounts of construction work that must be scheduled between now and 1982 are staggering. Our real capital investment will be in the neighborhood of a billion dollars.

37515 (EPA—600/7-79-167a, pp 48-86) **Energy, environmental, and economic impacts of flue gas desulfurization under alternative new source performance standards.** Van Horn, A.J.; Chapman, R.A.; Ferrell, G.; Cukor, P.M.; Large, D.B. (Teknekron, Inc., Berkeley, CA). Jul 1979.

From 5. flue gas desulfurization symposium; Las Vegas, NV, USA (5 Mar 1979).

The energy, environmental, and economic impacts of flue gas desulfurization (FGD) under alternative revisions to the New Source Performance Standards for coal-fired utility boilers have been examined using the Utility Simulation Model (USM). The USM simulates investment and operating decisions related to choices of fuels and pollution control equipment through the use of extensive data bases, and cost and performance models for pollution control, including control of SO_2, particulates, and NO/sub x/. For each of the 48 contiguous states in the US, alternative projections have been made of the impacts of utility operations from 1976 to beyond the year 2000. The SO_2 control technology and cost model is structured to calculate capital costs, variable operating costs, and capacity penalties for limestone, lime, and magnesium oxide FGD systems installed in module sizes of between 50 and 130 MW each, except for systems of less than 50 MW. The model is applied on a unit-by-unit basis utilizing a data base with detailed information on each existing and announced coal-fired utility boiler in the US. In calculating FGD system costs and penalties, the model considers both the gas flow rate and the quantity of SO_2 to be removed. This level of sophistication makes it possible, for instance, to compare FGD costs for the same coal at various emission limits, or for various coals with the same sulfur content but different heating values. This model is used in selecting a fuel and pollution control strategy as well as calculating the operating and cost functions for individual generating units in each year of the simulation. In this paper we summarize the recent sensitivity studies performed for EPA concerning the revised New Source Performance Standards to be established for coal-fired electric utility boilers.

37516 (EPA—600/7-79-167a, pp 137-214) **Economics and energy requirements of sulfur oxides control processes.** McGlamery, G.G.; Tarkington, T.W.; Tomlinson, S.V. (Tennessee Valley Authority, Muscle Shoals, AL). Jul 1979.

From 5. flue gas desulfurization symposium; Las Vegas, NV, USA (5 Mar 1979).

As part of a continuing program to evaluate the design, energy consumption, and economics of sulfur oxides control processes, this paper presents the results from three separate studies being carried out for EPA by TVA. Energy and preliminary economic requirements for three physical and three chemical coal-cleaning processes are given along with similar evaluations of a number of FGD processes. The FGD evaluations cover technical updates of older systems such as the lime and limestone throwaway processes and the magnesia and sodium scrubbing to produce sulfuric acid. In addition, a sulfur-producing option, Wellman-Lord scrubbing with coal reduction of SO_2 by Allied Chemical, is presented for the first time. In the future, changing conditions will require modifications to many of the premises used in these studies. Emission regulations, economic conditions, and industry practices are all changing. Premises covering equipment redundancy; particulate, SO/sub x/, and NO/sub x/ removal; waste disposal techniques; flue as bypassing; reduced on-stream time for boilers; and allowance for inflation over the operating life of the system are some which will be revised in the near future.

37517 (EPA—600/7-79-167a, pp 215-257) **Combined coal cleaning and FGD.** Kilgore, J.D. (Environmental Protection Agency, Research Triangle Park, NC). Jul 1979.

From 5. flue gas desulfurization symposium; Las Vegas, NV, USA (5 Mar 1979).

Physical coal cleaning (PCC) can be used to attain moderate reductions in the ash and sulfur levels of US coals. PCC can thus be used to generate compliance fuel for the less stringent State and Federal standards governing fossil fuel fired steam generators. The sulfur reduction requirements and emission levels which are likely to be specified in the revised New Source Performance Standards (NSPS) for electric utility boilers will preclude the use of coal cleaning as a sole method of complying with these flue gas desulfurization (FGD) regulations. The combined use of physical coal cleaning and flue gas desulfurization (PCC + FGD) will be the most effective method of complying with emission regulations, if the reduction in FGD and non-FGD costs which result from using cleaned coal are greater than the costs of PCC. Reductions in FGD costs by PCC can result from a reduction in the volume of flue gas treated (partial scrubbing) or the amount of sulfur removed from the flue gas stream. Reductions in fuel sulfur variability by PCC can lower design safety margins needed to ensure compliance for all fuel sulfur values. Non-FGD cost benefits can result from reduced boiler operation and maintenance costs, reduced transportation costs, reduced ash disposal costs, and reduced coal pulverization costs. Utility boilers which use high sulfur coals and which require sulfur removals less than 75% are likely candidates for PCC + FGD. If the revised NSPS for utility boilers require 90% sulfur removal and do not specify an emission floor, then PCC + FGD may not be competitive with FGD unless there are substantial non-FGD cost benefits associated with cleaning.

37518 (EPA—600/7-79-167a, pp 258-284) **Interagency flue gas desulfurization evaluation study.** Dickerman, J.C. (Radian Corp., Durham, NC); Stern, R.D. Jul 1979.

From 5. flue gas desulfurization symposium; Las Vegas, NV, USA (5 Mar 1979).

The approach and methodology used in this evaluation have provided an effective means of identifying research opportunities for enhancing the nearterm commercialization of FGD technology. Although the recommended program has not yet been formally approved, its impact has been felt in that several of the recommended RD and D opportunities have already been implemented. For example, in the lime/limestone process area, EPA has initiated work to evaluate the effects of adipic acid addition on SO_2 removal, and plans are being made to demonstrate forced oxidation at TVA's Widow's Creek Plant. EPRI has development programs under way to evaluate both cocurrent and sparged (Chiyoda 121) gas/liquid contactor designs. In the dual alkali area, EPA is planning to demonstrate the use of limestone as a regenerant with startup planned in early 1979 at the dual alkali test facility at Southern Services Company's Scholz Plant. In the regenerable process area, TVA and EPA have plans to cosponsor a magnesium oxide pilot plant to gather data for a full-scale system to be built by TVA. EPRI is planning RESOX and sorption steam stripping evaluations leading to a large-scale demonstration.

37519 (EPA—600/7-79-167a, pp 286-341) **Status of flue gas desulfurization in the United States.** Laseke, B.A.; Devitt, T.W. (PEDCo Environmental, Inc., Cincinnati, OH). Jul 1979.

From 5. flue gas desulfurization symposium; Las Vegas, NV, USA (5 Mar 1979).

Pedco Environmental, Inc., under contract to the Environmental Protection Agency, has closely monitored the growth and use of FGD technology by utilities in the United States and has evaluated FGD technology on both a general and a site-specific basis. The site-specific evaluations are based on visits to plants with operating FGD systems, during which process design and performance information and capital and annual cost data are obtained. Perhaps the most significant product of this project is the periodic summary reports which provide updated data on the number and capacity of the systems in operation, under construction, or planned and describe the performance of the operating systems during the reporting period. Utility representatives, system suppliers, system designers, regulatory personnel, and others contribute this informa-

tion voluntarily to facilitate the timely transfer of information in this key technological area. Information provided by utility representatives with operating systems is reported essentially as obtained; iittle attempt is made to analyze or interpret the data. Information provided by system suppliers and other sources is confirmed with the appropriate utility prior to publication. This paper addresses some of the highlights of the ongoing survey program.

37520 (EPA—600/7-79-167a, pp 342-385) **Recent results from EPA's lime/limestone scrubbing programs-adipic acid as a scrubber additive.** Head, H.N. (Bechtel National, Inc., San Francisco, CA); Wang, S.C.; Rabb, D.T.; Borgwardt, R.H.; Williams, J.E.; Maxwell, M.A. Jul 1979.

From 5. flue gas desulfurization symposium; Las Vegas, NV, USA (5 Mar 1979).

Adipic acid has been demonstrated as a powerful scrubbing additive for enhancing SO_2 removal in lime and limestone wet scrubbing tests both at EPA's IERL pilot plant at Research Triangle Park, North Carolina, and at the EPA-sponsored Shawnee Test Facility near Paducah, Kentucky. At adipic acid concentrations in the scrubber liquor in the range of 700 to 1500 ppM, SO_2 removals in excess of 90% have been consistently obtained with limestone slurry at both facilities. SO_2 removal was effectively enhanced even when operating with dissolved chlorides in the scrubber liquor as high as 10,000 ppM at the Shawnee Test Facility and 17,000 ppM at the IERL-RTP pilot plant. SO_2 removal was enhanced equally well in systems with or without forced oxidation. Adipic acid was found to cause only minor differences in the dewatering and handling properties of oxidized sludge. No scaling problems were encountered. Because of decomposition at scrubber operating conditions, consumption of adipic acid has been greater than anticipated, especially in systems with forced oxidation. To maintain 1500 ppM of adipic acid in the slurry liquor at Shawnee conditions, adipic acid consumption has been in the range of 8 to 9 lb/ton of limestone. A preliminary economic assessment by TVA comparing a base limestone case with adipic acid enhanced limestone for 90% SO_2 removal or better and using the actual adipic acid consumptions experienced at Shawnee indicates a reduction in annual revenue requirements of about 0.3 to 0.4 mill/kWh exclusive of ponding costs for systems with 750 to 1500 ppM of adipic acid.

37521 (EPA—600/7-79-167a, pp 418-449) **SO_2 and NO/sub x/ removal technology in Japan.** Ando, J. (Chuo Univ., Tokyo, Japan). Jul 1979.

From 5. flue gas desulfurization symposium; Las Vegas, NV, USA (5 Mar 1979).

The total operational FGD capacity in Japan has reached 33,000 MW equivalent with about 50 plants for utility boilers and numerous smaller ones for other flue gas sources. Major FGD plants have been operated with over 97% operability removing over 90% of SO_2. Through FGD, hydrodesulfurization of heavy oil, and import of low-sulfur fuels, ambient SO_2 concentrations have been reduced remarkably since 1967 - to levels low enough to meet the stringent air quality standard of 0.04 ppM in daily average or 0.02 ppM in yearly average. The increase in desulfurization plants has slowed down due partly to the successful reduction of ambient SO_2 concentrations, and partly to oversupply of by-products, and to the recent economic depression. The growing usage of coal for utility boilers, however, will necessitate more FGD plants. Recent efforts for air pollution control have been concentrated on NO/sub x/ abatement. In addition to combustion modification for numerous flue gas sources, over 60 commercial plants for selective catalytic reduction of NO/sub x/ in flue gases have been put into operation. Selective noncatalytic reduction (thermal de-NO/sub x/ has also been applied commercially or for large scale tests. The status of technologies, problems, and economics of SO_2 and NO/sub x/ removal in Japan is described.

37522 (EPA—600/7-79-167a, pp 450-468) **EPRI's FGD Program: from problem identification to development of solutions.** Preston, G.T. (Electric Power Research Inst., Palo Alto, CA). Jul 1979.

From 5. flue gas desulfurization symposium; Las Vegas, NV, USA (5 Mar 1979).

The overall objective of the Desulfurization Processes Program at Electric Power Research Institute is to develop the most reliable and cost effective flue gas desulfurization (FGD) technologies that can satisfy regulatory requirements. Through 1978 this objective was pursued primarily through evaluation of established techniques and development of emerging processes. Representative projects reviewed in this paper are lime scrubbing and sludge disposal guidelines; characterization of full-scale operating utility FGD systems; and pilot and laboratory efforts in absorption/steam stripping, RESOX, and an aqueous carbonate sodium regeneration process. In 1979, the emphasis of EPRI's program is shifting to evaluation and demonstration of advanced technologies, ranging from prototype evaluation of the concurrent scrubber configuration and the Chiyoda Thoroughbred 121 and RESOX processes, to the start of construction of one or more full-scale (100 MW) FGD systems.

37523 (EPA—600/7-79-167a, pp 469-485) **Cholla station unit 1 FGD system: 5 years of operating experience.** Travis, S.R.; Heacock, F.A. Jr. (Arizona Public Service Co., Phoenix). Jul 1979.

From 5. flue gas desulfurization symposium; Las Vegas, NV, USA (5 Mar 1979).

The Cholla Unit 1 FGD limestone throwaway system has been in commercial operation since December 14, 1973. The operations of this system has been characterized by high efficiency control of flue gas SO_2 and particulate matter at a high, sustained reliability factor. Trends in O and M costs demonstrate sound initial engineering and O and M concepts. Five years of operation give a data base of useful information on system component reliability and maintenance trends. Data available for performance of materials of construction in severe service is presented to support the use of corrosion resistant alloy materials. Based on the data and trends presented, extrapolations are discussed for process capabilities and for design and selection of equipment by generic type for reliable operation and acceptable maintenance.

37524 (EPA—600/7-79-167a, pp 486-507) **La Cygne Station Unit No. 1: wet scrubber operating experience.** Eaton, T.J. (Kansas City Power and Light Co., La Cygne). Jul 1979.

From 5. flue gas desulfurization symposium; Las Vegas, NV, USA (5 Mar 1979).

This paper reviews the present operating experiences of the Babcock and Wilcox designed scrubber system and continues to describe the trends of costs, availabilities, modifications, manpower and other supportive data relating to operations since June 1973. Early operations proved the need for protective walls to house the modules; heavier rotor blades and improved bearings for the induced draft fans drafting both the boiler and scrubber; cyclone separators to prevent scale and debris from plugging slurry nozzles; developing fast removal techniques and systems to remove huge piles of debris; constant surveillance to repair internal corrosion damage; learning the economical trade-off for exotic materials to withstand abrasion, corrosion or violent operation; establishing the need for minimal instrumentation for consistent operation due to terrific maintenance requirements; and undoubtedly the most important accomplishement was to establish an operating force that proved a scrubber burning coal with a very high sulfur and ash could be made to work effectively. The major problems currently affecting the scrubber system are corrosion and lack of commercially available instrumentation to monitor critical parameters affecting the scrubber operation.

37525 (EPA—600/7-79-167a, pp 508-525) **Dry FGD systems for the electric utility industry.** Lutz, S.J.; Chatlynne, C.J. (Environmental Protection Agency, Research Triangle Park, NC). Jul 1979.

From 5. flue gas desulfurization symposium; Las Vegas, NV, USA (5 Mar 1979).

Dry sorbent baghouse FGD technology has developed to the point where the basic FGD process is well understood. Commercialization has not been forthcoming due to the unobtainability of nahcolite in sufficient quantity. Research needs to be established into possible ways to reduce or eliminate the large consumption of this material by increasing utilization. Sorbent regeneration appears to be the most likely candidate but must be proven in pilot-scale testing before it can be applied to any commercial installations. Other research needs associated with the dry sorbent baghouse FGD system include further development of methods of insolubilization of the waste sorbent so that it can be disposed of in an environmentally acceptable manner. Spray dryer FGD technology has advanced at a very rapid rate and is now available commercially. Improvements in reducing the costs for these systems can be expected but will require extensive development. Regeneration of sorbents offers great promise in this area, but will require significant research and development before it is practical on a commercial scale.

37526 (EPA—600/7-79-167a, pp 526-560) **Plan, design and operating experience of FGD for coal fired boilers owned by EPDC.** Nakabayashi, Y,. (Electric Power Development Co., Ltd., Tokyo, Japan). Jul 1979.

From 5. flue gas desulfurization symposium; Las Vegas, NV, USA (5 Mar 1979).

EPDC has built Wet Limestone-Gypsum FGD systems for coal-fired boilers which are comprised of five 250MW class capacity, totaling 1280MW. Each of the FGD systems has been in service for three to four years with the same operating reliability as the boiler availability. EPDC is planning and constructing two 500MW and one 700MW coal fired plants to use imported coal and FGD Systems. EPDC is planning to start another 1000MW coal-fired plant in the near future. This paper describes the basic philosophy for design, specific design features, improvement of design resulting from operating experience, operating reliability, major problems and treatment of by-product.

37527 (EPA—600/7-79-167a, pp 613-628) **Limestone FGD operation at Martin Lake Steam Electric Station.** Richman, M. (Research-Cottrell, Somerville, NJ). Jul 1979.

From 5. flue gas desulfurization symposium; Las Vegas, NV, USA (5 Mar 1979).

The startup of the Flue Gas Desulfurization (FGD) System at Texas Utilities' Martin Lake Steam Electric Station, Unit No. 1, in April of 1977 marked the first use of FGD technology on a full-scale lignite installation. The station also features fully closed Loop FGD operation with no liquid waste streams generated, disposal of the truckable FGD sludge-fly ash solid waste product at the mine site, and the use of bypass gases for all scrubbed gas reheating. Since the startup, the Double-Loop/sub (TM)/ FGD Systems for Unit No. 1 and Unit No. 2 (June of 1978) have operated at well in excess of 95% absorber efficiencies and 90% reagent utilization while consuming less than 1.3% of the station's electrical power production. In addition the FGD Systems have been extremely reliable, causing only 5 days of unscheduled boiler downtime combined as of December 1, 1978. This paper, prepared by Research-Cottrell - the supplier of the FGD and Solids Handling Systems, presents a discussion of the Martin Lake S.E.S. FGD Systems design, startup, operating experiences to December 1, 1978, performance and operating requirements.

37528 (EPA—600/7-79-167b) **Proceedings: symposium on flue gas desulfurization.** Ayer, F.A. (comp.). (Research Triangle Inst., Research Triangle Park, NC (USA)). Jul 1979. 628p. (CONF-790371—(Vol.2)). NTIS.

From 5. flue gas desulfurization symposium; Las Vegas, NV, USA (5 Mar 1979).

This publication, in two volumes, contains the text of all papers presented at EPA's fifth flue gas desulfurization (FGD) symposium, March 5-8, 1979, at Las Vegas, Nevada. Papers cover such subjects as health effects of sulfur oxides, impact of FGD on the economy and the energy problem, energy and economics of FGD processes, actual operating experience, waste disposal and byproduct marketing, and industrial boiler applications. Twenty-one papers have been entered individually into EDB and ERA. (LTN)

37529 (EPA—600/7-79-167b, pp 629-653) **Basin Electric's involvement with dry flue gas desulfurization.** Janssen, K.E.; Eriksen, R.L. (Basin Electric Power Cooperative, Bismarck, ND). Jul 1979.

From 5. flue gas desulfurization symposium; Las Vegas, NV, USA (5 Mar 1979).

This report will introduce a relatively new technique of flue gas desulfurization using the dry scrubbing process. The dry scrubbing system introduces a reagent slurry, via an atomizer, into the flue gas where the SO_2 is absorbed by the reagent particles. The heat from the flue gas dries the particles in the reaction chamber. The particles are then collected in an electrostatic precipitator or a baghouse and disposed of dry, eliminating the sludge dewatering process needed for the wet scrubbing systems. Several reagents have been tested with soda ash and lime yielding the most favorable results. Atomization can be accomplished by either a rotary atomizer or spray nozzle. Baghouses and precipitators are known equipment in utility plants and spray dryers are operated in thousands of chemical and industrial plants around the world. Basin Electric Power Cooperative will use the rotary atomizer and baghouse collection at the Antelope Valley Station Unit 1 (440 MW) near Beulah, ND. The Y jet spray nozzle and precipitator collection will be used on the third unit (500 MW) of the Laramie River Station near Wheatland, WY. Reagents for both systems will be lime, due to its favorable economics over soda ash. It is estimated that the dry scrubbing system will save approximately $23 million at the Laramie River Station and $47 million at the Antelope Valley Station over the life of the plants compared to a wet scrubbing system for these site specific installations. We believe the utility industry will eventually accept the concept of dry scrubbing, not so much due to the economic factor, but because of the system's simplicity and potential high availability.

37530 (EPA—600/7-79-167b, pp 702-760) **Operating and status report, Wellman-Lord SO_2 removal/Allied Chemical SO_2 reduction flue gas desulfurization systems at Northern Indiana Public Service Company and Public Service Company of New Mexico.** Ross, D.W. (Davy Powergas Inc., Lakeland, FL); Petrie, J.; Link, F.W. Jul 1979.

From 5. flue gas desulfurization symposium; Las Vegas, NV, USA (5 Mar 1979).

This paper has been written in two sections. Section I contains an up-to-date report on the FGD plant at NIPSCO's Dean H. Mitchell Station at Gary, Indiana, and the most recent data pertaining to plant operations, problems encountered with corrective actions and anticipated plans for future plant operations. The FGD plant consists of the Davy/Wellman-Lord SO_2 Recovery Process and Allied Chemical Corporation's SO_2 Reduction Process. The plant information starts after the successful completion of the performance test on September 16, 1977, and continues to January 1, 1979. Section II has a report on Public Service Company of New Mexico, at Waterflow, New Mexico. This plant also consists of the Davy/Wellman-Lord SO_2 Recovery Process and Allied Chemical Corporation's SO_2 Reduction Process. The Wellman-Lord SO_2 Recovery Process is attached to power generation Units No. 1 and 2, and is composed of three operating sections: (1) Separate SO_2 Absorption for each power generation unit, (2) a dual train Chemical Regeneration Plant and single Purge Treatment Unit, and (3) a dual train Allied Chemical SO_2 Reduction Unit. This part of the report contains information beginning with the initial plant start-up in April 1978 and follows to January 1, 1979. It too will outline the plant operations, problems encountered with corrective action taken, and plans for continued plant operations.

37531 (EPA—600/7-79-167b, pp 761-791) **Citrate process demonstration plant: construction and testing.** Madenburg, R.S. (Morrison-Knudsen Co., Inc., Boise, ID); Crocker, L.; Cigan, J.M.; Oden, L.L.; Delleney, R.D. Jul 1979.

From 5. flue gas desulfurization symposium; Las Vegas, NV, USA (5 Mar 1979).

Construction of the Citrate Process Demonstration Plant represents a major milestone in the achievement of the Federal Bureau of Mines goal to minimize the undesirable environmental impact associated with SO_2 emissions from industrial sources. Baseline performance testing of the boiler prior to retrofit of the Citrate Process was conducted during November 1978. Mechanical testing, start-up and operational commissioning of the plant are now in progress. The demonstration of the Citrate FGD process at a 60 MWe coal-fired power generating station will confirm the design basis, the technical merits and the process's capital and operational economics at a commercial scale installation. This paper discusses the construction of the demonstration plant, the mechanical and pre-start-up testing, and the test and evaluation program. A brief description of the process, recent material evaluations and an assessment of application of citrate technology to other industrial SO_2 emitting sources are presented.

37532 (EPA—600/7-79-167b, pp 809-834) **Power plant flue gas desulfurization using alkaline fly ash from western coals.** Ness, H.M. (Dept. of Energy, Grand Forks, ND); Richmond, P.; Eurick, G.; Kruger, R. Jul 1979.

From 5. flue gas desulfurization symposium; Las Vegas, NV, USA (5 Mar 1979).

A characteristic of Western coals is that they contain high levels of alkali such as calcium, magnesium, and sodium. These alkali species can be leached from power plant fly ash for use in flue gas desulfurization (FGD) wet scrubbers in lieu of lime or limestone. At present, there are nearly 2600 MW's of generating capacity in the Western United States that utilize either fly ash or fly ash supplemented with lime or limestone. An additional 3500 MW's of Western generating capacity are being planned or are in various stages of construction which will use the alkaline fly ash. This report describes the Western alkali ash FGD systems. Two important characteristics of most Western coals is that they contain significantly less sulfur than most Interior and Eastern region coals, and that the coal ash contains high levels of alkali such as calcium, magnesium, and sodium. The significance of the generally low sulfur content, which averages about 0.7 pct, is that a sulfur dioxide removal efficiency of only 30 to 40 pct is required to meet the existing Federal emission standard of 0.52 g/MJ (1.2 lb SO_2/MM Btu), although higher removals are required to meet some state and local standards. The lower removal requirements have allowed novel developments in stack gas cleanup technology. The alkaline constituents in Western coals tend to be the highest in the low-rank lignites, and progressively less prevalent in the subbituminous and bituminous coals. The alkaline oxides in the ash can vary widely, ranging from under 10 pct to over 50 pct, with significant variations from mine to mine in a specific coal region, and even between locations within a single mine. Characteristic differences in coal ash compositions are illustrated in Table 1.

37533 (EPA—600/7-79-167b, pp 835-857) **Environmental effects of FGD disposal: a laboratory/field landfill demonstration.** Mohn, N.C. (Combustion Engineering, Inc., Windsor, CT); Plumley, A.L.; Tyler, A.L.; Van Ness, R.P. Jul 1979.

From 5. flue gas desulfurization symposium; Las Vegas, NV, USA (5 Mar 1979).

Results of an EPA-funded demonstration program for the conversion of fly ash and chemically treated sludge from sulfur removal scrubbers (AQCS) into a stabilized landfill having structural or recreational applications are discussed. An earlier paper (TIS-5485) described the laboratory studies and the preparation of field sites for the disposal of this waste. This paper covers efforts by Combustion Engineering, Inc. and Louisville Gas and Electric Co. to monitor the disposal sites over a two-year period. Properly prepared land fill from FGD sludge/fly ash mixtures will not contaminate the surrounding groundwater. Results obtained from analysis of leachates from the series of landfill impoundments in this study show that trace elements on the RCRA list of contaminants were found in concentrations below those established to characterize hazardous or toxic waste.

37534 (EPA—600/7-79-167b, pp 858-887) **Physical properties of FGD waste deposits at the Cane Run plant of Louisville Gas and Electric Company.** Ullrich, C.R. (Univ. of Louisville, KY); Hagerty, D.J.; Van Ness, R.P. Jul 1979.

From 5. flue gas desulfurization symposium; Las Vegas, NV, USA (5 Mar 1979).

Physical tests performed on FGD waste deposits include in situ shear strength determinations and in situ plate loading tests, as well as shear strength and permeability tests performed in the laboratory on samples taken from waste deposits at the plant. In situ testing and sampling were done at nominal intervals of 0 days, 30 days, 90 days, 180 days, and 360 days after field placement of wastes. Various mixtures of lime process FGD sludge, flyash and lime (or cement) were tested. EPA-sponsored testing of field deposits disclosed non-homogeneous and discontinuous conditions created by weather effects (freezing and thawing), interruptions in filling and incomplete mixing. Sample disturbance of the brittle cured wastes was severe; thus, lab strength values were low, about one-half the value of corresponding in situ test strengths. Lab permeability tests on field samples yielded values as much as two orders of magnitude higher than values obtained on lab-cured undisturbed samples. Permeability of field samples varied between 3×10^{-5} cm/sec and 3×10^{-6} cm/sec. In situ shear strength values 30 days after placement varied from about 250 psf to more than 3000 psf. Strength increases were noted with age for all but one deposit (which was disrupted by freezing). In situ strengths were much lower than strengths of samples cured and tested in the laboratory. Plate loading tests on selected deposits of wastes showed stiff fixed materials with bearing capacities greater than 15,000 psf. Freezing created layers in waste deposits and retarded or impaired stabilization reactions between lime and wastes. Some dewatering of exposed surfaces was caused by freezing and thawing. Commercial lime was more effective than carbide lime (a waste product available near the Cane Run plant) in stabilizing wastes and performed as well as Portland cement.

37535 (EPA—600/7-79-167b, pp 888-958) **Summary of utility dual alkali systems.** Kaplan, N. (Environmental Protection Agency, Research Triangle Park, NC). Jul 1979.

From 5. flue gas desulfurization symposium; Las Vegas, NV, USA (5 Mar 1979).

The Environmental Protection Agency (EPA) has been actively involved in the progressive development of dual alkali flue gas desulfurization (FGD) technology in the US from bench-scale to pilot plant to prototype to full-scale application. This logical progression has allowed a better understanding of the chemistry and made possible the identification of optimum levels of design and process parameters at a moderate cost. EPA continues to fund research and development activity aimed at identifying new variants of the process and efforts toward improving the existing processes, including the use of limestone for regeneration. This year is a major milestone in the application of dual alkali technology to full-scale utility systems in the US. Three full-scale systems ranging in size from 250 to 575 MW are scheduled to come onstream during 1979. The owners of these systems, their size, and the vendors providing them are: (1) Central Illinois Public Service Co., Newton No. 1, 575 MW unit, Envirotech; (2) Louisville Gas and Electric Co., Caine Run No. 6, 277 MW unit, Combustion Equipment Associates/Arthur D. Little, Inc.; and (3) Southern Indiana Gas and Electric Co., A.B. Brown No. 1, 250 MW unit, FMC. All of these systems are of the concentrated, sodium-based alkali type and they service boilers firing high-sulfur coal. This paper presents a brief description, the design bases, and a summary of vendor guarantees and reported costs for these systems. In addition, it presents the fundamentals of dual alkali technology, reviews the status of commercial dual alkali systems, and briefly describes some of the non-sodium sulfite based dual alkali processes.

37536 (EPA—600/7-79-167b, pp 959-988) **FGD reagent dilemma: lime, limestone, or thiosorbic lime.** Stowe, D.H.; Henzel, D.S.; Hoffman, D.C. (Dravo Lime Co., Pittsburgh, PA). Jul 1979.

From 5. flue gas desulfurization symposium; Las Vegas, NV, USA (5 Mar 1979).

Since SO_2 removal is a major expense, utilities will attempt to obtain SO_2 compliance at the lowest possible cost; including reliability and maintenance. In order to achieve this, one must realize that these interrelated unit processes - boiler operation, scrubbing, and waste disposal - effect SO_2 removal. Central to the optimization of these three processes is the selection of an alkaline reagent for SO_2 removal. The most prevalent reagents used today are limestone, lime, and Thiosorbic lime. This discussion will briefly review the basic chemistry involved with each reagent use, outline major advantages and disadvantages of each, and present a realistic example of the cost differences between limestone, lime, and Thiosorbic lime scrubbing.

37537 (EPA—600/7-79-167b, pp 991-1022) **Status of industrial boiler FGD applications in the United States.** Tuttle, J. (PEDCo Environmental, Inc., Cincinnati, OH); McAdams, R.M. Jul 1979.

From 5. flue gas desulfurization symposium; Las Vegas, NV, USA (5 Mar 1979).

PEDCo Environmental, Inc., under contract to the US EPA's Industrial Environmental Research Laboratory at Research Triangle Park, has been monitoring the status of industrial boiler flue gas desulfurization (FGD) applications since 1976. The information provided in this survey program has been obtained by visits to these industrial FGD sites, and through regular contact with company representatives, process designers, equipment suppliers, and government agencies. This paper summarizes the EPA Industrial Boiler FGD Survey report, including: the current (fourth quarter 1978) status of industrial FGD applications in the US, identifying the number of systems operating, under construction, or in a planning phase; a summary of system suppliers, including the number of systems served, processes offered, and total gas flow treated; a summary of FGD process types currently being implemented, with a discussion of some major installations, including system design and operating experience; and a summary of currently reported costs for the industrial FGD applications. Existing FGD applications in the industrial sector have generally shown that high reliabilities of system operation can be attained along with SO_2 removal efficiencies as high as 98%.

37538 (EPA—600/7-79-167b, pp 1067-1081) **Operating history and present status of the General Motors double alkali SO_2 control system.** Mason, T.O. (GMC, Parma, OH); Bangel, E.R.; Piasecki, E.J.; Phillips, R.J. Jul 1979.

From 5. flue gas desulfurization symposium; Las Vegas, NV, USA (5 Mar 1979).

The double-alkali type system was chosen because of its potential reliability over lime/limestone systems. The system is closed-loop with scrubbing being accomplished by use of a dilute caustic mixture and regeneration with lime. Each boiler has its own scrubber and caustic control. The lime regeneration system is common to all units. Additional draft fans were necessary to overcome the seven to eight inch pressure drop of the scurbbers. These fans are installed upstream of the scrubbers to avoid corrosion problems. The scrubbers have three bubble cap absorption trays and a mesh-type mist eliminator. This type of scrubber was chosen to obtain the highest sulfur dioxide removal along with maximum turndown potential. All wetted surfaces are constructed of 316L stainless steel. Caustic make-up to the scrubbers is determined by the pH of the liquor as it is recirculated. Liquid blowdown is diverted to two in-line reactor tanks where slaked lime slurry is added. These tanks overflow to a reactor clarifier where solids settling occurs and the lime reaction continues. The overflow from this clarifier goes to a second clarifier, where soda ash is added for softening and sodium make-up, and additional solids settling occurs. Overflow from the second clarifier is the make-up liquor used to replace blowdown at the scrubber.

37539 (EPA—600/7-79-167b, pp 1082-1114) **R-C/Bahco for combined SO_2 and particulate control.** Stevens, N.J. (Research-Cottrell, Inc., Somerville, NJ). Jul 1979.

From 5. flue gas desulfurization symposium; Las Vegas, NV, USA (5 Mar 1979).

The R-C/Bahco system controls SO_2 and particulate emissions in industrial applications where high performance is required. Research-Cottrell started up the system successfully on its first commercial application at Rickenbacker Air Force Base, Columbus, Ohio in March 1976. The scrubbing system has been operating at high availability (> 90%) since the Air Force took beneficial occupancy in September 1976. An EPA-sponsored test program was conducted to evaluate the viability of the R-C/Bahco technology for air pollution control. Effective SO_2 removal is accomplished using either a lime or limestone reagent. The Air Force switched from lime to limestone in May 1977 because of the substantial reagent cost savings. High particulate collection efficiencies (98 + %) are obtained for fly ash particle size above 1 to 2 microns. This paper describes the R-C/Bahco system installed at RAFB, evaluates its performance and operation and indicates costs and range of R-C/Bahco application for coal-fired industrial boilers. The R-C/Bahco scrubber system selected for this project simultaneously accomplishes SO_2 and particulate removal. It is based on technology developed by A.B. Bahco in Sweden and tested worldwide on oil-fired boilers, incinerators and other applications. The system installed at RAFB, represents the first application of the Bahco system in the US, and the first application worldwide on a coal-fired industrial boiler.

37540 (EPA—600/7-79-167b, pp 1115-1139) **Status of the project to develop standards of performance for industrial fossil-fuel-fired boilers.** Broz, L.D. (Acurex Corp., Raleigh, NC); Offen, G.R.; Anderson, P.D.; Mobley, J.D.; Sedman, C.B. Jul 1979.

From 5. flue gas desulfurization symposium; Las Vegas, NV, USA (5 Mar 1979).

The Environmental Protection Agency has undertaken a study of industrial boilers with the intent of proposing standards of performance based on information gathered during the project.

Through a series of tasks, background information is being collected on industrial coal-, oil-, and gas-fired boilers and the technologies that have demonstrated the ability to reduce nitrogen oxides, sulfur oxides, and particulate emissions from these sources. This information collection activity is nearing completion and will be followed by extensive analyses of the potential economic, energy, and environmental impacts of alternative regulatory options. The data and analyses will be documented in a Background Information Document and used to develop and support a New Source Performance Standard for the industrial boiler source category.

37541 (EPA—600/7-79-167b, pp 1140-1159) **Flue gas desulfurization applications to industrial boilers.** Dickerman, J.C. (Radian Corp., Durham, NC). Jul 1979.

From 5. flue gas desulfurization symposium; Las Vegas, NV, USA (5 Mar 1979).

This paper presents a summary of a study conducted to evaluate the applicability of various flue gas desulfurization (FGD) technologies for treating SO_2 emissions produced from industrial boilers. Results of this evaluation will be used by the EPA in preparing a NSPS for industrial boilers. Factors that were considered in evaluating the applicability of FGD technologies to industrial boilers included development status, capital and operating costs, energy requirements, environmental impacts, and performance and operating data.

37542 (EPA—600/7-79-167b, pp 1161-1178) **Stack gas reheat: energy and environmental aspects.** Muela, C.A. (Radian Corp., Austin, TX); Menzies, W.R.; Brna, T.G. Jul 1979.

From 5. flue gas desulfurization symposium; Las Vegas, NV, USA (5 Mar 1979).

Radian Corporation has completed a technical and economic assessment of stack gas reheat for the Environmental Protection Agency. The objectives were to: identify and analyze the potential problems associated with the generation of saturated flue gases by wet flue gas desulfurization processes; determine current flue gas reheating practices in the utility industry; determine how much reheat is actually required as well as its cost; and compare the costs of the various techniques that can be used to reheat flue gases. Background data were obtained from literature sources, from responses to questionnaires distributed to various users and suppliers of reheat equipment, and from visits to several facilities. The potential benefits and corresponding energy requirements associated with the use of stack gas reheat are discussed. Flue gas desulfurization (FGD) processes that cool and saturate flue gases with water may cause: corrosion of downstream equipment, a visible plume, acid rainout in the vicinity of a plant's stack, and increased groundlevel concentrations of pollutants. Electric utilities have cited equipment protection as the principal reason for the use of stack gas reheat. According to these users,the flue gas must normally be reheated by at least 16.7°C (30°F) to adequately protect equipment downstream of a wet FGD process. It is extremely difficult to quantify the amount of reheat actually required in any given application because each of the four problems just cited is resolved by different levels of reheat. In general, however, the results of the analyses indicate that reheating stack gases is an effective method of preventing the corrosion of downstream equipment, but is less effective in significantly reducing the other potential problems.

37543 (EPA—600/7-79-167b, pp 1179-1186) **Minimizing operating costs of lime/limestone FGD systems.** Johnson, C. (Peabody Process System, Inc., Stamford, CT). Jul 1979.

From 5. flue gas desulfurization symposium; Las Vegas, NV, USA (5 Mar 1979).

In summary it can be stated that the Peabody FGD System is extremely adaptable to a wide variety of operating conditions. What becomes significant in designing these systems is not only an understanding of the design conditions but also the normal operating conditions. This permits designing a system which produces the lowest operating cost to the owner. Alkali consumption and sludge handling costs are minimized by adjusting the L/G ratio and slurry pH to insure that no more than the required amount of SO_2 is removed. The use of the hydroclone provides the means for achieving 100% alkali utilization and thus stoichiometry is no longer an operating cost factor. Pumping power can be reduced by shutting off absorbers and reducing the L/G ratio to reflect load and SO_2 removal efficiency requirements. Operating the absorbers at reduced L/G ratio by shutting off one or more recycle pumps per absorber decreases the system pressure drop with corresponding fan horsepower saving.

37544 (EPA—600/7-79-167b, pp 1223-1234) **Dry FGD and particulate control systems.** Moore, K.A. (Rockwell International, Canoga Park, CA); Oldenkamp, R.D.; Schreyer, M.P.; Belcher, D.W. Jul 1979.

From 5. flue gas desulfurization symposium; Las Vegas, NV, USA (5 Mar 1979).

The process of SO_2 removal utilizing spray dryers is inherently simple. The process features the wet contact of SO_2 in flue gas with a mist of water containing a solution or slurry of alkali, typically either lime or soda ash. The SO_2 is absorbed in the mist water droplet and neutralized by the alkali. With boiler flue gas nominal temperatures of 300°F, the small quantity of water (about 0.3 gal per 1000 acf) in the alkali mist is completely evaporated. Thus, the flue gas is not saturated and remains warm. The exit gas temperature from the spray dryer is 150° to 200°F, a temperature safely above the water dew point. This technique results in particles of dry, spent alkali which have captured the SO_2. Essentially all of the particulate, including the fly ash, is then removed in product collection equipment (fabric filter or electrostatic precipitator). SO_2 removal efficiencies of 85% or more are achievable with particle emissions to the stack of less than 0.03 No./mBtu (~ 0.01 grain/scf). There are many benefits to keeping the flue gas warm and dry. The materials of construction can be of carbon steel with minimum risk of erosion, corrosion, or scaling. Spray dryer designs prevent wetting the walls of the vessel, and the dry alkali powder provides a renewable protective dust coating on chamber and duct surfaces. The flue gas is warm and dry at the exit of the product collection device; thus, reheat is not normally required to acheive plume dispersal out of the stack. The ID fan, downstream of the product collector, operates in a clean, low-temperature environment. Additionally, the resulting dry product eliminates the disposal problem of sludge ponds. The product is a free-flowing material that can be returned to the coal mine or another pit for final disposal.

37545 (PB—80-122708) **Citrate-process pilot-plant operation at the Bunker Hill Company. Report of investigations.** Crocker, L.; Martin, D.A.; Nissen, W.I. (Bureau of Mines, Salt Lake City, UT (USA). Salt Lake City Metallurgy Research Center). 1979. 83p. NTIS, PC A05/MF A01.

A goal of the Federal Bureau of Mines is to minimize the undesirable environmental conflicts and impacts associated with mineral processing operations. To help reach this goal, the Bureau operated a citrate-process pilot plant for the removal of sulfur dioxide from lead smelter sintering machine waste gases to test the process. The process uses a carboxylate solution such as citric acid to absorb sulfur dioxide from waste gases. The operation demonstrated that (1) 99 pct of the sulfur dioxide could be removed from lead smelter sintering machining waste gases containing from 0.1 to 0.6 vol-pct sulfur dioxide, (2) sulfur precipitation and solution regeneration with hydrogen sulfide in conventional stirred vessels was readily controlled, (3) precipitated sulfur could be continuously recovered as a 99.5-pct-pure product by flotation and melting, and (4) 78 dry-vol-pct hydrogen sulfide gas could be produced from pilot-plant product sulfur, natural gas, and steam.

37546 (PB—80-804404) **Coal mine waste (citations from the ntis data base). Report for 1964-Jan 80.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Feb 1980. 202p. NTIS PC N01/MF N01.

Research topics cover coal mining refuse, refuse dumps, and spoil. Studies on disposal, utilization, environmental impacts, and testing of these wastes are included, as are reports on land reclamation and spoil bank safety. (This updated bibliography contains 195 abstracts, 38 of which are new entries to the previous edition.)

37547 **Coal combustion fly ash characterization. Rates of adsorption and desorption of water.** Rothenberg, S.J.; Cheng, Y.S. (Inhalation Toxicology Research Inst., Albuquerque, NM). *J. Phys. Chem.*; **84**: No. 12, 1644-1649(12 Jun 1980).

Rates of adsorption and desorption of water by coal combustion fly ash have been measured over the temperature range 0 to 300°C. Adsorption isotherms and specific surface areas are summarized. Models for adsorption by fly ash and the assumptions underlying each model are reviewed. The change of rates with temperature and pressure predicted by each model is compared with experimentally determined values of half-times, t/sub 1/2/. The predicted values of t/sub 1/2/, obtained by using the model of Natusch and Tomkins, change by five orders of magnitude over the temperature range 0 to 300°C. The measured change is approximately two orders of magnitude. Measured values of t/sub 1/2/ for adsorption of water vapor at 0°C (1 to 4 torr) range from less than 1 min to 1 h. The rate data can be explained by either of the hypotheses that (1) fly ash is porous and mass transfer processes are rate controlling at some temperatures and pressures or (2) adsorption causes reversible changes (flexure) in the structure of fly ash.

37548 **Separating flue gas from regenerated cracking catalyst.** McGovern, S.J.; Schatz, K.W.; Zrinscak, F.S. Sr. (to Mobil Oil Corp.). US Patent 4,176,083. 27 Nov 1979. Filed date 25 Aug 1978. 6p.

The goal of the present invention is directed to the method and means for displacing entrained carbon dioxide and nitrogen and any other gaseous products of combustion from regenerated catalyst. These gases will be removed from a catalyst regeneration zone by a standpipe prior to passage and use of the catalyst in a hydrocarbon conversion operation.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 37486, 37533, 37534, 37546, 37572, 37573, 37591, 37641, 38084, 38667, 38675, 38692, 38694, 38697, 38724, 38728

37549 (ANL/EES-TM—99) **Overview of the environmental concerns of coal transportation.** Bertram, K.; Dauzvardis, P.; Fradkin, L.; Surles, T. (Argonne National Lab., IL (USA)). Feb 1980. Contract W-31-109-ENG-38. 75p. NTIS, PC A04/MF A01.

More than 30 environmental concerns were analyzed for the transportation of coal by rail, roads (trucks), high voltage transmission lines (that is, from mine-mouth generating plants to distribution networks), coal slurry pipelines, and barges. The following criteria were used to identify these problems: (1) real physical environmetal impacts for which control technologies must be developed, or regulation made effective where control technologies presently exist; (2) the level of impact is uncertain, although the potential impact may be moderate to high; (3) the concerns identified by the first two criteria are specific to or exacerbated by coal transportation. Generic transportation problems are not included. The significant environmental problems identified as a result of this study are: (1) rail transport - community traffic disruption and human health, safety, and habitat destruction; (2) coal haul roads - road degradation, traffic congestion and safety, air quality, and noise; (3) high voltage transmission lines - changed land use without local benefits, biological health and safety effects, and disruption of world weather patterns; (4) slurry pipelines - water availability, water quality, and possible spills from non-water slurry pipelines; and (5) barge transport - impacts common to all barge traffic. (DMC)

37550 (ANL/LRP—7) **Public views of reclaiming an abandoned coal mine: the Macoupin County project.** Bernard, J.R. (Argonne National Lab., IL (USA)). Jul 1980. Contract W-31-109-ENG-38. 81p. NTIS, PC A05/MF A01.

An abandoned underground coal mine waste area in Macoupin County, Illinois, has been reclaimed for demonstration and research purposes near the city of Staunton. According to federal law, end uses of reclaimed coal mines must be determined in part by local concerns. This study examined local residents' preferences for land uses and their social and economic evaluations of reclamation at the Macoupin County site. Personal interviews with 119 residents revealed preferences for recreational use of the demonstration area; however, responses were probably influenced by prior awareness of land-use intentions. Generally, very positive evaluations of the reclamation were received. Willingness to pay for reclamation appears to be linked to fulfillment of desired recreational uses on the site and socioeconomic status of the respondent. In general, the research results provide further evidence that the value of abatement of environmental damage from mining is recognized and supported in economic terms at the public level.

37551 (ANL/PAG—3) **Sampling and analysis of trace-organic constituents in ambient and workplace air at coal-conversion facilities.** Flotard, R.D. (Argonne National Lab., IL (USA)). Jul 1980. Contract W-31-109-ENG-38. 51p. NTIS, PC A04/MF A01.

A review of the recent literature reveals that current sampling procedures involve the use of glass fiber filters for particulate-sorbed organics and sorbent resins such as Tenax GC and XAD-2 for vapor-phase organics. Ultra trace-organic analysis of air pollutants or particulates may require the collection of a large (1000 to 3000 m^3) sample by a high volume air sampler. Personal air sampling requires a smaller ($\simeq$ 0.5 m^3) and a portable collection apparatus. Trapped organic chemicals are recovered by solvent extraction or thermal desorption of the collector. Recovered organics are separated by using liquid chromatography or gas chromatography and are identified by ultraviolet or fluorescence spectroscopy, gas chromatography, or mass spectrometry. For quantification, standards are added to the air stream during sampling or to the filter or resin following sampling. Analysis of the requirement for air sampling in and around coal conversion plants, coupled with the findings of the literature review, indicates that a combined particulate-filter and solvent-extractable-resin sampling unit should be used to collect both particulate-sorbed organics and vapor-phase organics from workplace or ambient plant air. Such a sampler was developed for stationary, moderate-to-high-volume air sampling. Descriptions of the sampler are provided together with sampling efficiency information and recommendations for a sampling procedure.

37552 (PB—80-126980) **Environmental standards for coal conversion processes. Volume I: most stringent, federal, and selected state regulations. Final report, Feb 1977-Jan 1979.** Webber, D.K.; Whittaker, D.E. (Pullman Kellogg, Houston, TX (USA)). Oct 1979. Contract EPA-68-02-2198. 268p. NTIS, PC A12/MF A01.

The report synopsizes existing and proposed environmental standards as a guide for evaluating the efficiency of available and developing technology for controlling liquid, gaseous, and solid wastes from coal conversion processes. Within the U.S., the Federal (including EPA) standards and guidelines for air, water, and solid wastes were gathered, together with standards for 22 states (selected for their potential in installing coal conversion facilities) and two regional commissions. Because environmental effects can cross national borders, standards and guidelines for Mexico, the Dominion of Canada, two Canadian provinces, and the International Joint Commission of U.S. and Canada were synopsized and added to the U.S. standards. All standards and guidelines were compared; from them the most stringent standards were summarized.

37553 (PB—80-133192) **Strip mine drainage--aquatic impact assessment. Report for Jun 1975-Dec 1977.** Cox, D.B.; Betson, R.P.; Barr, W.C.; Crossman, J.S.; Ruane, R.J. (Tennessee Valley Authority, Chattanooga (USA). Office of Natural Resources). Feb 1979. 100p. NTIS, PC A05/MF A01.

The overall objective of this research program is to demonstrate methodologies for predicting, on the basis of characteristics of the site to be mined, the impact of strip mining on downstream biotic communities. To accomplish this objective and provide data for model verification, sampling programs were initated at contour- and area-type mining operations. These progams include streamflow and rainfall gaging at both types of mines and surveys of fisheries, periphyton, and macrobenthos surveys at area-mined sites. Several model components have been developed, including a water quality model for non-point sources, a continuous streamflow model, and a storm hydrograph model.

37554 (UCID—18648) **Environmental report: proposed underground coal gasification experiment in the Tono Basin, Washington State.** Adamson, M.; Tonnessen, K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Sep 1980. Contract W-7405-ENG-48. 105p. NTIS, PC A06/MF A01.

The United States Department of Energy is sponsoring a program to select and characterize a potential underground coal gasification experiment site in western Washington State. This activity is evaluated with reference to possible environmental impacts in accordance with the National Environmental Policy Act. The following elements are integral parts of the analysis: (1) description of the proposed action and alternatives, (2) description of the existing environment, (3) potential environmental impacts of the project, and (4) recommendations for measures to mitigate impacts. Field reconnaissance and environmental data collected from both state and county agencies and from local individuals and organizations form the basis for an evaluation of the potential impact of the project on this riparian ecosystem. A cultural resource survey was also conducted as part of the site evaluation. Points of environmental sensitivity include the potential for damage due to air emissions and groundwater contamination, maintenance of surface water quality and minimization of disruption of wildlife habitat. Possible mitigation measures to protect environmental quality are recommended.

37555 (DOE/TIC—11286) **Environmental assessment of synfuels projects.** Boston, C.R. (Oak Ridge National Lab., TN (USA)). [nd]. Contract W-7405-ENG-26. 9p. NTIS, PC A02/MF A01.

The Oak Ridge National Laboratory is assisting the Department of Energy (DOE) in environmental assessments of synfuels demonstration projects. This activity includes the preparation of environmental impact statements for all six of DOE's demonstration plants. The synfuels technologies include high-BTU gasification, medium-BTU gasification and liquefaction.

RESERVES AND EXPLORATION

37556 **Future coal prospects: country and regional assessments.** Greene, R.P.; Gallagher, J.M. (eds.). Contract EX-76-A-01-2295. Cambridge, MA; Ballinger Publishing Co. (1980). 577p.

This report contains a detailed description of the prospects for coal prepared by teams from each of the sixteen countries paticipating in the World Coal Study (WOCOL), as well as studies for other regions of the world. The WOCOL countries included Austria, Canada, China, Denmark, Finland, France, Germany, India, Indonesia, Italy, Japan, Netherlands, Poland, Sweden, United Kingdom, and the United States. Non-WOCOL countries and regions included Republic of South Africa, East and Southeast Asia, Latin America, and Africa. The levels of coal production and use that each country estimates will be needed are included; and also the policy and infrastructure actions required to reach such levels. It showed how coal can meet a major part of the increased energy needs within each country, and be mined, moved, and used in ways which meet stringent environmental standards. (DP)

MINING

REFER ALSO TO CITATION(S) 37546, 37553, 37556, 37592

37557 (DOE/EIA—0119(78)) **Coal: Pennsylvania ant hracite 1978. Energy data report.** Watson, W. (Department of E nergy, Washington, DC (USA). Energy Information Administration). Oct 1980. 20p. NTIS, PC A02/MF A01.

Production of Pennsylvania Anthracite in 1978 decreasec 1 14.1 percent or 824 thousand short tons from the 1977 figure of 5861 thousand short tons to 5037 thousand short tons. Buckwheat N lo. 1 and smaller sizes accounted for 3768 thousand short tons o r 75 percent of production. Pea and larger sizes accounted for 1259 thousand short tons or 25 percent of production. Average price per ton (f.o.b. preparation plant) increased 1.1 percent from the 1 977 figure of $34.86 to $35.25. Productivity declined 6.6 percent fr om 6.97 to 6.51 short tons per miner per day. Domestic distribution of anthracite in 1978 totaled 3895 thousand short tons or 77.3 percent of production. Of this amount, 1597 thousand short tons or 41 perce nt went to residential and commercial consumers, 1064 thousand sho rt tons or 27.3 percent went to electric utilities, 748 thousand short to ns or 19.2 percent went to other industrial users, 476 thousand sho rt tons or 12.2 percent went to the iron and steel industry, and 10 thousand short tons or 0.3 percent was consumed at mining ope r-ations. US exports of anthracite in 1978 totaled 1142 thousand sho rt tons or 22.7 percent of production. Exports to Canada were 40 5 thousand short tons, to South Korea - 331 thousand short tons, an d to US military forces in West Germany - 276 thousand short tons. The Canadian, Korean, and German exports accounted for 101 2 thousand short tons or 88.6 percent of all exports in 1978.

37558 (DOE/TIC—11269) **Methane recovery from coalbeds : project plan document, FY 1981.** (Department of Energy, Morgantown, WV (USA). Morgantown Energy Technology Center). Sep 1980. 41p. NTIS, PC A03/MF A01.

The Methane Recovery from Coalbeds Project was initiated by DOE to foster the utilization of the resource as an alternate fuel source. Since its inception in FY 1978, the project has made significant progress in the development of the technology base. In addition, the project has more clearly identified technology needs, potential uses, and some of the environmental, legislative, and social barriers. Some of the major milestones are as follows: over 30 wells have been drilled, cored, logged, and tested and well test reports prepared for the open file; six reports have been issued defining the characteristics of coal basins, including updated estimates of the coalbed methane resources; research has been performed on fracture mechanics, stimulation, directional drilling, and horizontal drilling; environmental, economic, and legal aspects of the technology have been researched; ten production technology development projects are either in progress, or have been completed; and over 100 technical papers have been prepared and presented. While the project has made significant progress, development of coalbed methane as a contributing source to the US gas market supply is far from complete. Innovative systems for recovery and utilization of coalbed methane must be further developed to enable production of the resource at competitive prices. Without the development of efficient systems, coalbed methane associated with mining will mainly be wasted by venting into the atmosphere, and the methane associated with unmined coalbeds will continue to reside in the coal. It is therefore imperative that the project be continued to its maturity.

37559 (EPA—600/7-79-111d) **Integrated assessment of Texas lignite development. Volume IV. Executive summary.** (Environmental Protection Agency, Washington, DC (USA). Office of Energy, Minerals and Industry). May 1979. 41p. NTIS, PC A03/MF A01.

Growth in Texas' overall energy demand, in general, and electrical demand, in particular, is expected to exceed national rates. It is anticipated that lignite use will be confined entirely to the utility and industrial sectors. The nominal case calls for Texas electric utility generation to grow by 5.3 percent per year from 1978 to 1987 and by 4.3 percent from 1987 to 2000. These rates, which represent the current projections of the state's utility industry, would increase energy consumption by the state's electric utilities from 1.8 quadrillion Btu's (Quads) in 1978 to 4.8 Quads in 2000. The nominal case for industrial energy consumption is consistent with earlier forecasts by TEAC and DOE, based on projections of economic activity. The rates used for industrial energy consumption (primarily process heat, process steam and on-site electrical power production) are 3.8 percent per year for the 1975 to 1990 period and 3.2 percent annually for 1990 to 2000. This growth results in an increase in industrial consumption from 2.4 Quads in 1978 to 5.2 Quads in 2000. An analysis of current plans for the use of coal and lignite by utilities in Texas indicates that through 1987, approximately 60 percent of the solid fossil fuel demand will be met by lignite. The factors listed all tend to increase the competitiveness of lignite over western coal. Thus, it appears that in the time frame of this study, lignite will continue to be the preferred fuel over imported coal. However, in the post-2000 era, lignite use may be surpassed by western coal as lignite reserves are depleted. By 2000, coal may also be imported from the Midwest.

37560 (FE—9047-1) **Application of maintenance management techniques to underground coal mining face equipment. Final technical report, November 30, 1979.** Hill, F.E.; Lilly, P.B. (Ayers (Emory) Associates, Inc., New York (USA)). Nov 1979. Contract AC01-77ET12479. 73p. NTIS, PC A04/MF A01.

In theory, the four mines studied installed full-fledged maintenance systems that included reorganization of the maintenance function, planning, scheduled preventive maintenance and planned repairs, performance reporting, and supply and training support. In practice, however, only Mine No. 2 installed a complete and efficient program, albeit on a test basis; the others permitted weaknesses to creep in in varying degrees and with various results. We can draw three conclusions from the study of the test mines: face equipment availability can reach 95% when good-quality daily preventive maintenance and periodic scheduled maintenance shifts are performed; a scheduled maintenance shift frequency of as much as 33% (one maintenance shift during every three scheduled shifts) and generally not less than 11% (one maintenance shift during every nine scheduled shifts), will usually lead to optimum levels of productivity, production, and face equipment availability; and percent changes in productivity (tons per unit shift) are usually greater than corresponding percent changes in face equipment availability (this assumes constant reliability of out-by haulage equipment).

37561 (FE—9047-2) **Application of maintenance management techniques to underground coal mining face equipment. Final technical report, November 30, 1979.** Hill, F.E.; Lilly, P.B. (Ayers (Emory) Associates, Inc., New York (USA)). Nov 1979. Contract AC01-77ET12479. 246p. NTIS, PC A11/MF A01.

The program described in this manual requires considerable participation from underground maintenance and production personnel. In addition, the establishment of a maintenance planner or maintenance planning department is key to: scheduling major maintenance operations, coordinating management information and focusing resources to resolve critical problems.

37562 (FE—9144-1(Vol.1)) **Performance evaluation of Automatic Extraction System. Volume I. Executive summary. Final technical report.** Frantz, R.L.; King, R.H.; Bartsch, D.L. (Pennsylvania State Univ., University Park (USA). Dept. of Mineral Engineering). Jul 1980. Contract AC01-77ET12207. 35p. NTIS, PC A03/MF A01.

Field testing of the AES was performed at Consol's McElroy Mine located in West Virginia's northern panhandle. The in-mine trial was originally scheduled for a five month operating period. However, special circumstances caused the trial to last nine months including a three month miner strike interval. During the in-mine trial, the full time audit team observers documented all events on every production shift and on 94% of the maintenance shifts in a Comprehensive Field Documentation program. Any conclusions and observations to date regarding the operating performance on machine capabilities of the AES first generation experimental model must always be tempered with the full knowledge that the machine operated on only 21 of 71 available production days because of a combination of machine breakdowns, modifications and adverse geological conditions. A substantial amount of additional in-mine experimentation and production is required before any degree of meaningful validation can be attributed to any of the AES components by performance evaluation studies. However, it is believed that certain strengths and weaknesses of the particular mining concept and specific machine construction can be postulated on the basis of the very limited but factual McElroy Mine observations. This report, which is the first in a series of six, provides an executive summary of the project. Four major areas are addressed in this volume. First is a statement of the assignment or scope of work. Second, the method utilized to accomplish the work is reviewed. Third, the summary and conclusions of the investigation are presented. And fourth, a presentation of the major recommendations for improvement necessary to enhance the performance of the AES.

37563 (FE—9144-1(Vol.2)) **Performance evaluation of Automatic Extraction System. Volume II. Performance evaluation of the AES. Final technical report.** Frantz, R.L.; King, R.H.; Bartsch, D.L. (Pennsylvania State Univ., University Park (USA). Dept. of Mineral Engineering). Jul 1980. Contract AC01-77ET12207. 161p. NTIS, PC A08/MF A01.

The National Mine Service Company's Automatic Extraction System (AES) was the first hardware development of Automatic Remote Controlled Continuous Miner (ARCCM) researchers. The AES was designed to be a continuous mining system that combined the cutting and loading functions with complete roof control, auxiliary ventilation, and environmental controls. The AES machine used the well developed framework of a Marietta 3080 Drum Miner to combine many face functions into one machine. It weighed 75 tons and was 38.3 ft long. The AES cut an entry 15 ft wide, using a 3-ft dia drum mounted with carbide-tipped bits. It retracted to 13.3 ft for clearance when tramming and was capable of cutting an entry 10 ft high. The cutting drum was tapered on the ends so that the corners of the entry were rounded to increase roof support. The drum, turning at a rate of 57 rpm, produced a bit tip speed of 535 fpm. The gathering head used four ribbed-discs to load coal onto the armored chain conveyor. The advantages of the disc-type head were reduced

noise and smoother flow of the coal onto the conveyor causing less spillage. Temporary roof support was accomplished with overhead metal beams mounted on ten hydraulic cylinders. Permanent support was afforded by four roof-bolting units mounted at 4-ft intervals across the machine. Located about 19 ft from the front of the AES, the units were used to install a row of 5-ft resin roof bolts with each 4 ft of advance.

37564 (FE—9144-1(Vol.3)) **Performance evaluation of Automatic Extraction System. Volume III. AES field documentation. Final technical report.** Frantz, R.L.; King, R.H.; Bartsch, D.L. (Pennsylvania State Univ., University Park (USA). Dept. of Mineral Engineering). Jul 1980. Contract AC01-77ET12207. 76p. NTIS, PC A05/MF A01.

The full-time reporting of an in-mine experimental mine trial is a comprehensive subject requiring in-depth objective evaluation of the relationship between men, machinery, and geological conditions. The quantitative performance assessment results from objective tests developed to evaluate anticipated advantages and problems of the AES operation. The study documents all facets of machine experimental field operation to inform present and future researchers of the mining system capability in its applied environment. This report, the third in a series of six, provides a detailed description of the Comprehensive Field Documentation procedure used to measure and record the performance of the AES in the aspects of safety, production, performance, economics, and human factors. Two major areas are addressed in this volume. First is the data collection plan for (1) the full-time production and maintenance audit; (2) the worker-opinion questionnaire audit; and (3) special audits. Second is the reporting procedure utilized.

37565 (FE—9144-1(Vol.4)) **Performance evaluation of Automatic Extraction System. Volume IV. Recommended operating, maintenance, and training plans. Final technical report.** Frantz, R.L.; King, R.H.; Bartsch, D.L. (Pennsylvania State Univ., University Park (USA). Dept. of Mineral Engineering). Jul 1980. Contract AC01-77ET12207. 55p. NTIS, PC A04/MF A01.

Since the AES is a different and more sochisticated machine, it became apparent during the in-mine trial that more than on-the-job training (OJT) is desirable for the operators. The AES is unique in that it should remain in the face for long periods rather than be moved often from the face to face. In addition, the operator should learn to trust the ACS in order to be more aware of the hazards in the face area. More training is one way to help increase operator and machine efficiency and safety consciousness. The lack of formal, organized, scheduled, non-productive-mode training of the AES operators appeared to affect the performance of the AES during mining, tramming, maneuvering, and bolting. Therefore, before the operator and bolters do their jobs and the mechanics maintain the AES on a regular basis in a production-mode, they should attend classes, including: (1) formal above ground classroom training, (2) non-productive-mode underground training, and (3) productive-mode OJT. The training department should have the authority and resources to train workers beforehand, and also whenever subsequent instruction is needed. This plan includes only those areas peculiar to the AES. It is assumed that mature, competent individuals (operators and bolters) have already been trained to use similar machines. If this is not the case, the training will require significantly more time.

37566 (FE—9144-1(Vol.5)) **Performance evaluation of Automatic Extraction System. Volume V. Geotechnical investigations of the roof conditions in the area mined by the AES machine. Final technical report.** Bieniawski, Z.T.; Rafia, F.; Newman, D.A. (Pennsylvania State Univ., University Park (USA). Dept. of Mineral Engineering). Jul 1980. Contract AC01-77ET12207. 85p. NTIS, PC A05/MF A01.

This report presents the results of an in-depth geotechnical investigation aimed at assessing the roof, floor, and coal pillar conditions in the area mined by an experimental Automatic Extraction System (AES), built by National Mine Service Co. The study included diamond core drilling, borescope observations, and detailed engineering geological mapping in Consolidation Coal's McElroy coal mine in West Virginia. The field investigations were accompanied by regional geology studies involving aerial photography and lineament analysis as well as by laboratory testing of 103 rock and coal samples. The roof conditions were interpreted by means of an engineering rock mass classification system, known as the Geomechanics Classification. It was found that the roof quality in the areas mined by the AES machine was poor and that the action of the AES support beams could be detrimental to the overall roof stability. Improvements in the procedures for evaluating future AES-type mining are suggested.

37567 (FE—9144-1(Vol.6)) **Performance evaluation of Automatic Extraction System. Volume VI. An assessment of AES operation on mine strata. Final technical report.** King, R.H.; Frantz, R.L. (Pennsylvania State Univ., University Park (USA). Dept. of Mineral Engineering). Jul 1980. Contract AC01-77ET12207. 36p. NTIS, PC A03/MF A01.

The full-time reporting of an in-mine experimental mine trial is a comprehensive subject requiring in-depth objective evaluation of the relationship between men, machinery, and geological conditions. The quantitative performance assessment results from objective tests developed to evaluate anticipated advantages and problems of the AES operation. The study documents all facets of machine experimental field operation to inform present and future researchers of the mining system capability in its applied environment. The recommended methods, techniques, and alternatives for selecting and applying various documentation techniques are based on a review and critical evaluation of the methods reported in the literature and applied in the field. They are presented in a series of six reports which are suggested as a user's manual for Comprehensive Field Documentation of underground innovative mining machine applications. This report which is the last of a series of six assesses the action of the AES machine on mine roof and floor strata. The report also evaluates proposed modifications to the AES roof-support unit and recommends further modifications.

37568 (PB—80-119514) **Evaluation of coal mine electrical system safety. Annual progress report 1 Jan-31 Dec 77.** Morley, L.A.; Trutt, F.C.; Kohler, J.L. (Pennsylvania State Univ., University Park (USA). Dept. of Mineral Engineering). 31 Jan 1978. 46p. NTIS, PC A03/MF A01.

This report contains four principal chapters covering accomplishments in the mine electrical safety research areas of continuous monitoring, battery and battery-charging safety, and computer modeling. Highlights of the work are summarized in the last report chapter.

37569 (PB—80-122690) **Directional drilling for coalbed degasification. Program goals and progress in 1978. Report of investigations.** Oyler, D.C.; Diamond, W.P.; Jeran, P.W. (Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Mining and Safety Research Center). 1979. 21p. (BM-RI—8380). NTIS, PC A02/MF A01.

The Bureau of Mines is cooperating with the U.S. Department of Energy in a directional degasification project at the Emerald mine near Waynesburg, Pa. This project is designed to combine the highly successful underground horizontal desgasification technology with surface drilling methods. The objective of this program is to demonstrate that directional drilling can be used as a technique for degasifying coalbeds ahead of mining to reduce the hazards of methane-air explosions in coal mines.

37570 (PB—80-133929) **Geology of the single-entry project at Sunnyside coal mines 1 and 2, Sunnyside, Utah. Report of investigations.** Scheibner, B.J. (Bureau of Mines, Spokane, WA (USA). Spokane Mining Research Center). 1979. 114p. NTIS, PC A06/MF A01.

This Bureau of Mines report describes the geology and physical properties of core samples at the Sunnyside, Utah, and was written in conjunction with the Single-Entry Program conducted at the mine. The objective of this program was to test the hypothesis that the single-entry system in the Sunnyside mine, supported in the center by open cribs and divided by a fire-resistant partition, is equivalent to or better than a two-entry system. Drill cores, taken underground at 15 sites in the single-entry study area, facilitated the construction of geologic cross sections of the entries. Physical property data obtained from the drill cores were used in a three-dimensional finite element analysis program to evaluate the stability of the openings, the support requirements, and the deformation characteristics of the roof and floor material. Data on 10 physical property parameters for 5 rock types plus coal are also tabulated and discussed.

37571 (PB—80-134372) **Effect of symmetric bit wear and attack angle on airborne respirable dust and energy consumption. Report of investigations 1979.** Hanson, B.D.; Roepke, W.W. (Bureau of Mines, Twin Cities, MN (USA). Twin Cities Mining Research Center). 1979. 29p. NTIS, PC A03/MF A01.

The Bureau of Mines conducted a series of experiments using four different coal types to determine the effect of attack angle and symmetric bit wear on airborne respirable dust (ARD) generated by point-attack bits and in energy consumption. Neither had a significant effect on ARD at the 95-pct confidence level, but bit wear had a significant effect (95 pct confidence) on specific energy (energy per gram of cut coal) for three coal types. Depth of cut was the most significant factor affecting ARD and specific energy.

37572 (PB—80-134489) **Surface mining and fish/wildlife needs in the eastern United States. Addendum.** Samuel, D.E.; Stauffer, J.R.; Hocutt, C.H.; Mason, W.T. Jr. (West Virginia Univ., Morgantown (USA). Div. of Forestry). Apr 1979. 127p. NTIS, PC A07/MF A01.

An addendum to FWS/OBS-78/81, Surface Mining and Fish/Wildlife Needs in the Eastern United States - Proceedings of a Symposium, this report includes some papers which were not ready for the publication deadline for the main volume. It continues to be a state-of-the-art overview on surface mining in the eastern United States and the fish/wildlife relationships; best methods for measuring

mining impacts; the effects of mining on the biota; mined land reclamation techniques for fish/wildlife benefits; and opportunities for improving fish/wildlife habitat on mined lands.

37573 (PB—80-142003) **Surface and subsurface water quality hydrology in surface mined watersheds. Part I: text. Final report, Jul 1974-Jan 1977.** McWhorter, D.B.; Rowe, J.W.; Van Liew, M.W.; Chandler, R.L.; Skogerboe, R.K. (Colorado State Univ., Fort Collins (USA)). Aug 1979. Contract EPA-R-803175. 215p. NTIS, PC A10/MF A01.

Surface mining disturbs the natural sequence of geologic strata, and, therefore, potentially modifies the quantity and quality of water on a watershed disturbed by surface mining. Such a watershed disturbed by surface mining was monitored in Colorado. In addition, surface runoff, subsurface drainage, and sediment production were studied on a plot scale in the field. The most significant effect of mining on water quality was an increase in dissolved solids. Models were used to analyze water quality and hydrologic data and to estimate the contribution of the mined area to the total salt load. The effect of surface mining on water quality and flow patterns in aquifers were estimated.

37574 (PNL—3320) **Wire rope improvement program. Fiscal years 1979 to 1980. Interim report.** Morgenstern, M.H.; Alzheimer, J.M.; Anderson, W.E.; Beeman, G.H.; Rice, F.C.; Strope, L.A.; Werry, E.V. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Aug 1980. Contract AC06-76RL0183O. 112p. NTIS, PC A06/MF A01.

This report describes the work performed by the Pacific Northwest Laboratory and its subcontractor Battelle Columbus Laboratories on the Wire Rope Improvement Program during FY-1979 and the first half of FY80. The program, begun in 1975 by the US Bureau of Mines, was transferred to the US Department of Energy (DOE) on October 1, 1978. Since that time, the DOE's Division of Solid Fuels Mining and Preparation has sponsored the program. To address identified problems and provide information from which behavior of large-diameter wire rope could be better understood, efforts in the following areas were undertaken: large-diameter rope testing, small-diameter rope testing, data analysis and evaluation, wear and failure analysis, load sensor development, and technology transfer. Wire ropes 3/4 in., 1-1/2 in., and 3 in. in diameter were tested in bend-over sheave fatigue. Attempts were made to correlate fatigue life of these ropes. Limited field rope data were available to compare with test results. The modes of failure and wear in laboratory ropes were compared with those seen previously in field ropes. A load sensor was designed and ordered in FY79. It will be connected to the drag rope and jewelry of working draglines during the summer of FY80. Technology transfer was achieved through disseminating written materials, conducting seminars, holding a national symposium, and filming of selected field operations.

37575 (SAND—80-0227) **Continuum finite element approach for rock failure and rubble formation.** Beazley, S.E.; Krieg, R.D. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1980. Contract AC04-76DP00789. 24p. NTIS, PC A02/MF A01.

A continuum finite element formulation that models the failure of a rock mass, the collapse of this rubble into a void space and the associated bulking of the rubble is presented. This formulation is incorporated into a finite element computer program that treats the large deformation nonlinear motion of axisymmetric and two-dimensional continua. A dynamic relaxation procedure is used for the solution algorithm. Example calculations are given that demonstrate the formulation.

37576 (TID—28233/3) **Technical assessment of patents related to underground coal mine haulage. Appendix, Volume 3, Other haulage.** (Engineers International, Inc., Downers Grove, IL (USA)). Feb 1978. Contract AC01-76ET12480. 67p. NTIS, PC A04/MF A01 Portions of this document are illegible.

Several patents relating to underground coal mining are evaluated. The designs of shuttle cars, conveyors, hydraulic mining equipment, mining machines, tunneling machines, pneumatic conveyors, continuous miners, dust collectors, and spraying apparatus are included. DMC

TRANSPORT AND HANDLING

REFER ALSO TO CITATION(S) 37480, 37552, 38362

37577 **Flocculation of coals with water-soluble starch xanthates.** Maher, G.G. US Patent Application 6,080,733. [nd]. Filed date 1 Oct 1979. 10p.

Powdered coals are rapidly flocculated from aqueous suspensions by the simple addition of water-soluble starch xanthate, thereby producing a readily recoverable sediment phase and a substantially clear aqueous phase.

37578 (DOE/IA/10066—01) **Overview of United States coal export terminals.** (Soros Associates, New York (USA)). Sep 1980. Contract AP01-80IA10066. 57p. NTIS, PC A04/MF A01.

Existing coal export ports in the United States are in general not designed to the standards compatible with the current state of the art. The United States has a current coal export capacity in the order of 83 million tons per year. This could be increased to 138 million tons per year through a process of modernization and expansion which would take about six to eight years for full realization. Even if this expansion program took place it would not result in an overall coal export system that was economically competitive due to the fact that our export terminals are generally outmoded and cannot accommodate the large vessels engaged in the world coal trade and which can be accommodated at the major coal destination ports in Europe and Japan. In order for the United States to achieve an economically competitive posture in the world coal trade, new ports that will handle 150,000 to 250,000 DWT ships are needed. The new terminals must be designed to receive coal efficiently and minimize the demurrage costs for both railcars on the delivery side and ships on the load out side. There are port sites available in the US which could be developed to effectively handle the increased requirements. Each major new port could easily be designed to handle 20 to 50 million tons per year at ultimate capacity subject to the availability of coal from the source at a reasonable cost. New port construction is needed to satisfy the projected demand at a reasonable cost and to provide for the obsolescence of existing facilities. Decisions are needed now so that the ports will be operating 20 years from now and serve as replacements for present facilities which are becoming obsolete. The government of the United States can and must play a major role if success is to be achieved.

37579 (EPRI-CS—1517(Vol.1)) **Coal preparation using magnetic separation. Volume 1. Magnetic separation study of Magnex processed coal.** Porter, C.R.; Goens, D.N. (Nedlog Technology Group, Arvada, CO (USA)). Jul 1980. 79p. NTIS, PC A05/MF A01.

The EPRI funded program was instituted to assess the capability of commercially available magnetic separators to process carbonyl treated coals from the Magnex Process. The Magnex Process is a dry beneficiation process which involves: (1) crushing, (2) heating, (3) carbonyl treatment, and (4) magnetic separation. The coal is crushed to nominally minus 4-mesh prior to treatment. The crushed coal is heated to approximately 170°C (338°F) then subjected to iron carbonyl vapors. Pyrite and ash are removed from the coal with low to medium intensity magnetic separators. Four kilogram samples of Magnex Processed coal were sent to each of five vendors who were interested in the applicability of their equipment for use in the Magnex Process. Three vendors, Eriez, Reading US, and Carpco demonstrated the capability to separate the magnetic material from the carbonyl treated coal using induced-magnetic-roll (IMR) separators. Each vendor evaluated and recommended the magnetic separator they considered most capable of handling the carbonyl treated coal. The IMR Separator was most often recommended and produced the best results by the vendors. A test program was initiated using the Eriez IMR Separator in conjunction with the Magnex Pilot Plant to optimize the IMR parameters of feed rate, current, roll speed, magnetic gap, size magnetic coil current, magnetic coil resistance, divider settings, and size fraction. The resulting preferred values for the parameters are attached on Table 1-1.

37580 (EPRI-CS—1517(Vol.2)) **Coal preparation using magnetic separation. Volume 2. Final report.** Stekly, Z.J.J.; Mallary, M.L.; Segal, H.R. (Magnetic Corp. of America, Waltham, MA). Jul 1980. 50p. NTIS, PC A03/MF A01.

Wet magnetic separation tests have been performed on two coals (Eastern Associated Delmont coal and Old Ben coal) using a superconducting magnet. Pyritic sulfur reductions in excess of 86% were achieved for both coals with corresponding yields of 60% by weight of clean coal product. Ash reductions in the range from 60 to 80% were also obtained. These results were obtained with flow velocities ranging from 1 to 4 cm/sec, slurry concentrations between 10 and 33% and magnetic field strengths of 20 and 50 kilogauss with a stainless steel wool matrix for generating high gradients. A conceptual design for a 110 ton/h superconducting magnetic separator is presented. Capital cost for the equipment for this separator is estimated to be $600,000.

37581 (EPRI-CS—1517(Vol.3)) **Coal preparation using magnetic separation. Volume 3. Final report.** Weschler, I.; Doulin, J.; Eddy, R. (Sala Magnetics, Inc., Cambridge, MA (USA)). Jul 1980. 88p. NTIS, PC A05/MF A01.

Research objectives were to determine the degree of coal desulfurization that can be achieved with wet high-gradient magnetic separation, to study the effects of operating conditions on coal cleaning, to establish correlations between performance of a small cyclic separator and a large continuous unit, and to estimate the capital costs which might be associated with commercial high-gradient magnetic coal cleaning. These objectives were accomplished by testing five eastern and midwestern coals in SALA-

HGMS laboratory and pilot-plant separators under a variety of experimental conditions. Good correlation was found between performance of the two separators when run with the same feeds and under equivalent operating conditions. Up to 82% of the pyritic sulfur in the feed was removed in the separators, and ash reductions of up to 60% were also accomplished. Separation performance was found to be sensitive to coal type, mesh of feed grind, and separator operating conditions. The classic mineral-processing conflict between product grade and recovery was encountered throughout the program. For example, the 82% maximum pyritic-sulfur reduction was accomplished with a clean-coal yield of only 37%. However, numerous tests were performed in which high levels of desulfurization were achieved with reasonable coal recoveries. A preliminary economic analysis was performed for a hypothetical commercial beneficiation facility, using performance data acquired in the experimental program. The analysis indicated that capital investment for magnetic separation equipment in such a facility could range from $27,844 to $71,856 per ton of hourly capacity. These estimates apply only to the specific coals studied in the test program.

37582 (EPRI-CS—1517(Vol.4)) **Coal preparation using magnetic separation. Volume 4. Evaluation of magnetic fluids for coal beneficiation. Final report.** Sladek, T.A.; Cox, C.H. (Colorado School of Mines, Golden (USA). Research Inst.). Jul 1980. 74p. NTIS, PC A04/MF A01.

Research objectives were to acquire a body of information on the properties and potential applications of magnetic fluids, to study the selective coating behavior of magnetic fluids when contacted with a mixture of organic an inorganic matter, and to determine the extent of coal beneficiation that can be acccomplished with fluid-enhanced magnetic separation. Objectives were achieved by performing an extensive literature survey and by acquiring and testing samples of three fluids and several commercially-important domestic coals. Coal beneficiation tests were conducted in a high intensity induced-roll dry magnetic separator and in a high-gradient matrix-type wet magnetic separator. The induced-roll device could not beneficiate untreated coal, but high yields of magnetic clean coal were obtained when the feed was first pretreated with magnetic fluid. The high-gradient separator did achieve substantial coal beneficiation of untreated coal, and level of coal cleaning increased moderately when the feed was pretreated with magnetic fluids. However, yield of the nonmagnetic clean coal decreased. All magnetic fluids tested exhibited the ability to wet both organic and inorganic surfaces but showed a preference for organic surfaces. Testing of a high-ash preparation-plant refuse indicated that the organic fluid was capable of selective attachment to the organic components of a complex feed mixture.

37583 (PB—80-128143) **Environmental assessment of coal cleaning processes: technology overview. Final report, Jul 1976-May 1979.** Spaite, P.W.; Robinson, G.L.; Lemmon, A.W. Jr.; Min, S.; McCreery, J.H. (Battelle Columbus Labs., OH (USA)). Sep 1979. Contract EPA-68-02-2163. 92p. NTIS, PC A05/MF A01.

The report gives a background against which requirements for further developments of coal cleaning technology and control techniques for the associated pollutants can be established, as part of a review of U.S. coal cleaning process technologies and related technologies for environmental control. It summarizes the state of the art of physical coal cleaning. It summarizes the status of coal cleaning technology with respect to cost, energy efficiency, applicability, extent of development, and commercialization prospects. It describes the manner in which various physical coal cleaning operations are combined to produce systems capable of producing minimum, intermediate, and maximum levels of coal cleaning. It describes the physical and chemical properties of coal, and cites the pertinent literature on washability of many U.S. coals. It gives technological descriptions of coal cleaning processes. It identifies potential pollutants evolved from these processes and methods used for their control.

37584 **Fluorinated hydrocarbons in coal mining and beneficiation.** Smith, C.D.; Keller, D.V. Jr. (to Otisca Industries, Ltd.). US Patent 4,178,233. 11 Dec 1979. Filed date 31 Jul 1978. 52p.

A method of using fluorinated hydrocarbons as a carrier to convey mined coal to a separation station is described. The carrier acts as a parting liquid for beneficiating the coal. The carrier is recovered and returned to the mine for conveying more coal. Some of the returned carrier may be used at the mining face as a dust suppressant. Ash from burning the coal may be returned with the carrier where it is disposed of as waste material.

37585 (ORNL-tr—4675) **Study of the fundamentals for process control of hard coal preparation.** Leininger, D.; Ludke, H. (Bergbau-Forschung G.m.b.H., Essen (Germany, F.R.)). May 1979. Translation source information not available . 28p. NTIS, PC A03/MF A01.

The research activities on the fundamentals of process control in hard coal preparation are subdivided in following tasks: development and testing of instantaneous measuring devices; mathematical description of the process steps involved and establishment of a simulation model; and structuring a computer-aided coal preparation system. Among the devices for instantaneous measurements of moisture, ash, and sulfur contained in coal, only the instantaneous measuring device for ash content has been commissioned and proved its suitability for certain applications. The simulation model of hard coal preparation has been established and is suited for planning tasks. The replacement of process functions by comprehensive mathematical descriptions of processes and appertaining equipment has not yet been completed so that process control will be possible only in certain sections. In the framework of introducing a computer-aided coal preparation system, practical trials were carried out with regard to the control of processes appropriate for transforming intermediary preparation products into saleable products. The present state of development work both in the fields of process technology (mathematical description) as well as measuring technology (reliable instantaneous measuring devices) is not yet sufficient for any process optimization.

COMBUSTION

REFER ALSO TO CITATION(S) 37512, 38077, 38372, 38373, 38374, 38564, 38565

37586 (CONF-800428—(Vol.1)) **Proceedings of the Sixth International Conference on Fluidized Bed Combustion. Volume 1. Plenary sessions.** (Courtesy Associates, Inc., Washington, DC (USA)). Aug 1980. Contract FG01-80ET16024. 119p. NTIS, PC A06/MF A01.

From 6. international conference on fluidized bed combustion; Atlanta, GA, USA (9 Apr 1980).

The Sixth International Conference on Fluidized Bed Combustion was held at the Atlanta Hilton, Atlanta, Georgia, April 9-11, 1980. The papers in this volume involved presentation of the research and development programs of the US (US DOE, TVA, EPRI and US EPA), United Kingdom, Federal Republic of Germany and the People's Republic of China. Eight papers from Vol. 1 (Plenary Sessions) of the proceedings have been entered individually into EDB and ERA. (LTN)

37587 (DOE/ET/15166—T1) **Development of regenerable sorbents for fluidized bed combustion. Quarterly progress report No. 1, September-December 31, 1979.** Kalfadelis, C.D.; Gaydos, T. (Exxon Research and Engineering Co., Linden, NJ (USA)). 1979. Contract AC01-79ET15166. 22p. NTIS, PC A02/MF A01.

In the initial work on the current program, equipment employed in the original pioneering study, including a thermogravimetric analyzer, an associated gas-mixing panel, and sorbent pellet preparation and conditioning hardware, was accumulated, tested for operability, refurbished, reinspected and recalibrated for future use. Specifications were prepared for the fabrication of a laboratory-scale hot fluidized bed test unit, and a design for this system was completed by our Mechanical Division. As a means to reinitiate the laboratory program and to test our equipment, new formulations incorporating the calcium aluminate cements (CAC) and barium titanate ($BaTiO_3$) materials, which were found to be the most promising sorbent candidates in the original study, were prepared and tested. Titanium dioxide, when incorporated into calcium aluminate cement formulations, produced an improvement in SO_2 absorption performance and, up to a level of about 5 weight percent, did not degrade crush strengths appreciably. Incorporation of carbon black and/or flyash into TiO_2-containing CAC formulations produced additional absorption improvement, but significantly reduced sorbent crush strengths. Several promising leads were pursued in the reformulation of barium titanate compositions. But it is apparent that this line of research must be considerably extended to achieve improvements of the type desired.

37588 (DOE/TIC—11279) **Reactions of HS radicals important in coal combustion. Quarterly technical progress report, July-September 1980.** Wampler, F.B. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 11p. NTIS, PC A02/MF A01.

In the combustion of fossil fuels, large amounts of sulfur containing pollutants such as SO_2 and H_2S are formed. Although radicals such as HS and SO are important precursors to these pollutants, very little kinetic information exists to provide input parameters to develop kinetic models for assessing the reactions of these radicals. The primary objective of this research is to determine the rate constants and Arrhenius parameters for the reactions of the HS radicals which are of importance in coal combustion chemistry. In this report we present the status of our current research effort in developing a laser-induced fluorescence (LIF) diagnostic for HS. The principal advantage of such a technique is that the measurements are made in real-time and are not dependent upon the ultimate product formation whereby secondary reactions may mask or alter the desired kinetic information. The fact that the sampling process is done with no physical intervention of the reaction system and with a

minimal amount of product contamination makes the method extremely attractive.

37589 (ORNL/TM—7398) **Tennessee Valley Authority atmospheric fluidized-bed combustor simulation interim annual report, January 1-December 31, 1979.** Wells, J.W.; Krishnan, R.P. (Oak Ridge National Lab., TN (USA)). Oct 1980. Contract W-7405-ENG-26. 171p. NTIS, PC A08/MF A01.

This report contains a detailed description of the work performed during 1979 for the Tennessee Valley Authority in support of the TVA Fluidized-Bed Combustor (FBC) Demonstration Plant Program. The work was carried out under task 4, modeling and simulation of atmospheric fluidized-bed combustor (AFBC) systems. The overall objective of this task is to develop a steady-state mathematical model with the capability of predicting trends in bed performance under various feed and operating conditions. As part of this effort, three predictive subprograms (subcodes) were developed during 1979: (1) bubble-growth subcode, (2) sorbent-coal ash elutriation and attrition subcode, and (3) coal combustion subcode. These codes, which are currently being tested with experimental data, are capable of predicting how some of the important operating variables in the AFBC affect its performance. After testing against field data, these subcodes will be incorporated into an overall AFBC system code, which was developed earlier at ORNL for analysis of the Department of Energy (DOE) Component Test and Integration Unit (CTIU) at Morgantown, West Virginia. In addition to these predictive subcodes, the overall system code previously developed for the CTIU is described. The material balance is closed, based on vendor-supplied data. This balance is then used to predict the heat transfer characteristics of the surfaces (submerged and freeboard) in the AFBC. Existing correlations for heat transfer in AFBC are used in the code along with thermophysical properties of the various streams.

37590 **Carbonaceous fuel combustion with improved desulfurization.** Yang, R.T.; Shen, M.S. (to Dept. of Energy). US Patent 4,191,115. 4 Mar 1980. Filed date 23 Jun 1978. 8p.

PAT-APPL-918,618.

Lime utilization for sulfurous oxides adsorption in fluidized combustion of carbonaceous fuels is improved by impregnation of porous lime particulates with iron oxide. The impregnation is achieved by spraying an aqueous solution of mixed iron sulfate and sulfite on the limestone before transfer to the fluidized bed combustor, whereby the iron compounds react with the limestone substrate to form iron oxide at the limestone surface. The iron oxide present in the spent limestone is found to catalyze the regeneration rate of the spent limestone in a reducing environment. Thus both the calcium and iron components may be recycled.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 37582, 38081, 38236

37591 (DOE/RA/08726—T2) **Effects of the DOE proposals for new source performance standards for utility boilers firing anthracite coal.** (Environmental Research and Technology, Inc., Concord, MA (USA)). Oct 1978. Contract AC01-77RA08726. 18p. NTIS, PC A02/MF A01.

Currently, the most important expansion market for anthracite is the electrical utilities/power generation area, where the major competitors are other forms of coal. However, anthracite is more expensive to mine than bituminous coal and requires more expensive boilers and other plant equipment. Advantages of anthracite include its geographic location and, most importantly, its low sulfur content and slightly higher heating value relative to bituminous coal. Because of these factors, anthracite is competitive with bituminous coal as a utility boiler fuel only under those NSPS scenarios that permit significantly lower SO_2 removal costs for an anthracite-fired plant. The cost of electricity under various NSPS scenarios was calculated for a hypothetical 600 Mw 0.7% S anthracite-fired power plant located at, and supplied by, an open-pit mine in eastern Pennsylvania. Calculated costs were compared with those of a comparable of 2% S bituminous-fired plant at the same location. Because of the lower sulfur content of anthracite, the DOE sliding scale alternative would permit significantly lower SO_2 removal costs for the anthracite plant. For the example case considered, the DOE sliding scale would have the effect of making anthracite competitive with bituminous coal as a utility boiler fuel (as would a flexible interpretation of the EPA 85% scrubbing standard), i.e., electricity costs would be essentially equal. As discussed in detail in a previous report (ERT, 1978) the revitalization of the Pennsylvania anthracite industry would carry with it the potential for significant environmental and socioeconomic benefits in northeastern Pennsylvania. Uncertainties which might affect the viability of increased anthracite production under alternative NSPS proposals are discussed.

37592 (ORAU—171) **Statistical profile of major coal-producing firms, 1978.** Baker, J.G.; Bishop, R.C. (Oak Ridge Associated Universities, Inc., TN (USA). Manpower Education, Research and Training Div.). Sep 1980. Contract AC05-760R00033. 16p. NTIS, PC A02/MF A01.

This report examines major coal-producing groups, which are firms controlling output of 3 million or more tons annually. Characteristics of the major producing groups, such as their percentage of US output, their ownership by companies in coal, steel, oil, etc., and their regional concentration, are compared using 1966 and 1978 data. On the basis of mine-level data for 1978, a cross-section of mines controlled by major producers is compared to one of mines controlled by smaller firms for differences in markets, coal prices, transportation, distribution of output, technology, and other characteristics. Finally, such measures of efficiency as output per miner-shift and scale characteristics by market type (such as captive versus open), consumer (steam or steel), and controlling group are examined.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 37551, 37568, 37641, 38856, 38860, 38878

LEGISLATION AND REGULATIONS

REFER ALSO TO CITATION(S) 37552, 38229, 38234, 38235

PETROLEUM

REFER ALSO TO CITATION(S) 38289

RESERVES

REFER ALSO TO CITATION(S) 38238

GEOLOGY AND EXPLORATION

REFER ALSO TO CITATION(S) 37635, 37650, 37950, 38895

37593 (DOE/BC/00015—16) **Investigation of low-invasion coring fluids. Annual report, October 1, 1978-September 30, 1979.** McFall, A.L.; McGuire, P.L. (Sandia Labs., Albuquerque, NM (USA); Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Technology Center). Oct 1980. Contract AT19-78BC00015. 19p. NTIS, PC A02/MF A01.

A new pressure coring system has been developed which could significantly improve the measurement of in-situ oil and gas saturations in hydrocarbon reservoirs. This improved system incorporates a low-invasion fluid that is stored in the core retriever and is extruded to seal and protect the core. The low-invasion fluid consists of an extremely viscous, brine-based polymer system with sized calcium carbonate bridging particles to minimize invasion. This special coring fluid has been selected from several candidates that were laboratory tested at simulated downhole conditions. Both static and dynamic filtration characteristics were considered. Other important properties of this low-invasion pressure coring fluid are discussed, including freezing point, formation damage, clay stabilization, wettability changes, and pressure buildup in the core barrel. Preliminary results from actual coring operation are also presented.

37594 (DOE/ET/14317—T1) **Report of the workshop on Arctic oil and gas recovery held at Sandia National Laboratories, Albuquerque, New Mexico, June 30-July 2, 1980.** Sackinger, W.M. (ed.). (Alaska Univ., Fairbanks (USA). Geophysical Inst.). Sep 1980. Contract AC01-80ET14317. 54p. NTIS, PC A04/MF A01.

This report is the result of a workshop on Arctic offshore oil and gas recovery, held at Sandia National Laboratories Albuquerque, New Mexico, on June 30-July 2, 1980. Research priorities for the technology related to Arctic offshore oil and gas production were defined. The workshop was preceded by a report entitled, A Review of Technology for Arctic Offshore Oil and Gas Recovery, authored by Dr. W. M. Sackinger. The mission of the workshop was to identify research priorities without considering whether the research should be conducted by government or by industry. Nevertheless, at the end of the meeting the general discussion did consider this, and the concensus was that environmental properties should certainly be of concern to the government, that implementation of petroleum operations was the province of industry, and that overlapping, coordinated areas of interest include both environment and

interactions of the environment with structures, transport systems, and operations. An attempt to establish relative importance and a time frame was made after the workshop through the use of a survey form. The form and a summary of its results, and a discussion of its implications, are given.

37595 Some results from continuum mechanics analyses of the hydraulic fracturing process. Hanson, M.E.; Shaffer, R.J. (Lawrence Livermore Lab, Calif). *Soc. Pet. Eng. J.;* **20**: No. 2, 86-94(Apr 1980).

Some results are presented of theoretical analyses performed as part of a Department of Energy (DOE)-sponsored ongoing research program which is being conducted to develop an understanding of petroleum reservoir stimulation techniques. The results presented here are being performed to understand and predict those reservoir properties and parameters that can limit the created hydraulic fracture geometries. 24 refs.

37596 Pore systems in carbonate rocks and their influence on hydrocarbon recovery efficiency. Wardlaw, N.C. (Univ. of Calgary, Alberta). pp 24p, Paper E of Geology of carbonate porosity. Tulsa, OK; American Association of Petroleum Geologists (1979).

In the initial stages of dolomitization (50% to 70%), the porosity either remains constant or tends to decrease slightly, but at higher dolomite contents, both porosity and permeability commonly increase abruptly. An empirical scheme is proposed for an approximate estimation of oil recovery efficiency from visual observations on resin pore casts of carbonate reservoir rocks. (DLC)

DRILLING AND PRODUCTION

REFER ALSO TO CITATION(S) 38544

37597 Enzymatic method for improving the injectability of polysaccharides. Griffith, W.L.; Compere, A.L.; Holleman, J.W. (to Dept. of Energy). US Patent Application 090,176. [nd]. 17p.

A method for enhancing the ability of polysaccharides in aqueous solution to flow through a porous medium comprises contacting the polysaccharides with an endoenzyme capable of hydrolyzing at least one of the linkages of the sugar units of the polysaccharides and maintaining the polysaccharides in contact with the enzyme under hydrolysis conditions for a time sufficient to decrease the tendency of the polysaccharides to plug the porous medium yet insufficient to decrease the viscosity of the aqueous polysaccharides by more than 25%. The partially hydrolyzed polysaccharides are useful as thickening agents for flooding water used to recover oil from oil-containing subterranean formations.

37598 (ANL/ES—103) **Petroleum reservoir data for testing simulation models.** Lloyd, J.M.; Harrison, W. (Argonne National Lab., IL (USA)). Sep 1980. Contract W-31-109-ENG-38. 81p. NTIS, PC A05/MF A01.

This report consists of reservoir pressure and production data for 25 petroleum reservoirs. Included are 5 data sets for single-phase (liquid) reservoirs, 1 data set for a single-phase (liquid) reservoir with pressure maintenance, 13 data sets for two-phase (liquid/gas) reservoirs and 6 for two-phase reservoirs with pressure maintenance. Also given are ancillary data for each reservoir that could be of value in the development and validation of simulation models. A bibliography is included that lists the publications from which the data were obtained.

37599 (CONF-800750—) **1980 annual heavy oil/EOR contractor presentations: proceedings.** (Keplinger and Associates, Inc., Tulsa, OK (USA)). Sep 1980. Contract AC19-80BC10033. 451p. NTIS, PC A20/MF A01.

From Meeting for DOE enhanced oil recovery project; San Francisco, CA, USA (22 Jul 1980).

Twenty-five papers were presented on thermal recovery, chemical flooding, and carbon dioxide methods for enhanced oil recovery. Separate abstracts were prepared for 24 of the papers; the remaining paper was previously abstracted. (DLC)

37600 (CONF-800750—, pp 11-16) **Bodcau In-Situ Combustion Project, Bossier Parish, Louisiana.** Garvey, J. (Cities Service Co., Jackson, MS). Sep 1980.

From Meeting for DOE enhanced oil recovery project; San Francisco, CA, USA (22 Jul 1980).

Primary production from the field, discovered in 1921, amounted to only 5% of the original oil-in-place. Wells were drilled in 1976 through 1979 for in-situ combustion recovery. 551,203 bbl were produced through May 1980, with a peak rate of 601 bbl/day in April 1978. Project recovery to date is 79% of the total estimated recoverable reserves of 700,000 bbl. (DLC)

37601 (CONF-800750—, pp 17-19) **Lynch Canyon thermal drive oil recovery project.** Stair, J.R. (Mobil Oil Corp., Newport Beach, CA). Sep 1980.

From Meeting for DOE enhanced oil recovery project; San Francisco, CA, USA (22 Jul 1980).

In September, 1978 Mobil-GC Corporation (formerly General Crude Oil Company) and the US DOE entered into a DOE cost-sharing contract to jointly fund the Lynch Canyon Combination Thermal Project. Objective was to demonstrate and evaluate the recovery of a very viscous crude oil using the Combination Thermal Drive process aided by cyclic steam injection in a large-scale field operation. Four wells were drilled, but due to unfavorable economic conditions, the project was terminated.

37602 (CONF-800750—, pp 21-28) **Steamflood demonstration pilot Williams holding lease, Cat Canyon Field, Santa Barbara County, California.** Adamson, G.R.; Hanzlik, E.J. (Getty Oil Co., Ventura, CA). Sep 1980.

From Meeting for DOE enhanced oil recovery project; San Francisco, CA, USA (22 Jul 1980).

The S1-B sand of Cat Canyon produces a 9°API crude oil with an average viscosity of 25,000 centipoises. In 1976, it was decided to conduct a joint steamflood pilot. Injection began in April 1977. Overinjection, channeling, and low sandface steam quality caused high water production and low oil production. Injection was suspended in February 1980. 5 figures. (DLC)

37603 (CONF-800750—, pp 29-33) **200 Sand Steamflood Demonstration Project.** Alford, W.O. (Santa Fe Energy Company, Santa Fe Springs, CA). Sep 1980.

From Meeting for DOE enhanced oil recovery project; San Francisco, CA, USA (22 Jul 1980).

This project is testing an enhanced steamflooding technique in the Midway-Sunset Field, Kern County, California. Continuous injection was initiated October 1975, with a total injection of 2.07 million bbl steam by June 1980. The injection wells averaged only 220 bbl/d/well. The steam generators are now being moved to a centralized steam plant. 2 figures. (DLC)

37604 (CONF-800750—, pp 35-45) **Field demonstration of the conventional steam drive process with ancillary materials.** Eson, R. Sep 1980.

From Meeting for DOE enhanced oil recovery project; San Francisco, CA, USA (22 Jul 1980).

To evaluate the ability of ancillary materials as additives to the conventional steam drive process, six steam injection patterns were chosen. Four patterns are being treated with sequential injection slugs of a steam foam or a steam foam/gel combination, and two patterns will remain untreated and be used as control patterns. Injection profiles, chemical tracer surveys, casing vent gas emission tests, and production and temperature tests will be obtained along with a monitoring of the residual oil saturations. The residual oil saturations are obtained through the use of periodic Carbon Oxygen cased hole logs in observation wells which were drilled, cored and cased as a part of this project. To properly correlate the data obtained, final data wells will be drilled and cored near the end of the project, adjacent to the original observation wells.

37605 (CONF-800750—, pp 47-49) **Field demonstration of the conventional steam drive process with ancillary materials.** Sep 1980.

From Meeting for DOE enhanced oil recovery project; San Francisco, CA, USA (22 Jul 1980).

Laboratory and field studies of the efficiency of foams for limiting the injection of steam into thief (depleted) zones are described. Small amounts of inert gas will have to be injected along with the steam in order to develop flow resistance following the injection of a slug of foam stabilizer. Air will be used as the inert gas for the first field tests. (DLC)

37606 (CONF-800750—, pp 51-85) **Investigation of reactions occurring in in-situ combustion.** Fassihi, M.R.; Brigham, W.E. (Stanford Univ., CA). Sep 1980.

From Meeting for DOE enhanced oil recovery project; San Francisco, CA, USA (22 Jul 1980).

From the continuous analysis of produced gases from a small packed bed reactor, several sequential reactions were distinguished. Using four different crude oils, it was found that the reactions can be divided into three global reactions. Omission of any of these in the numerical simulators can lead to erroneous results. Clay was found to enhance fuel deposition. It also speeds up the combustion reaction and its effect should be taken into account in the field. 18 figures, 4 tables.

37607 (CONF-800750—, pp 87-109) **Tracer related studies.** Abbaszadeh-Dehghani, M.; Brown, S.L.; Brigham, W.E. (Stanford Univ., CA). Sep 1980.

From Meeting for DOE enhanced oil recovery project; San Francisco, CA, USA (22 Jul 1980).

Determination of height and permeability for a multi-layer system was begun by Yuen, Brigham, and Cinco-Lay. This work described the tracer concentration by relating it to the volume of fluid injected in a five-spot pattern. A computer program was

written which calculates the thickness and permeability of each layer determined from inputed peak values. A maximum of five peaks could be chosen. Brown and Brigham extended this work to have a maximum of ten inputed peaks. Abbaszadeh and Brigham are continuing this study to find solutions for different pattern sizes and different mobilities. This paper presents the results obtained by Brown and Brigham for field data and recent work by Abbaszadeh and Brigham correlating breakthrough curves of different water flooding patterns with a mobility ratio of one.

37608 (CONF-800750—, pp 125-144) **Relative permeability of low tension systems at elevated temperatures.** Amaefule, J.O.; Handy, L.L. (Univ. of Southern California, Los Angeles). Sep 1980.

From Meeting for DOE enhanced oil recovery project; San Francisco, CA, USA (22 Jul 1980).

This paper presents the results of a laboratory investigation of the effect of low interfacial tensions (IFT) on oil-water relative permeability curves. The effect of various IFT values on capillary pressures were evaluated. The relative permeabilities to oil and water at a given water saturation were found to increase with decreasing interfacial tensions. The capillary pressure decreased as expected and showed a shift towards lower saturations with decreasing tensions, indicating some possible wettability alteration. The irreducible water and residual oil saturations decreased as interfacial tension decreased.

37609 (CONF-800750—, pp 145-159) **Screening of foaming agents for use in steam injection processes.** Owete, O.S.; Al-Khafaji, A.; Wang, F.; Castanier, L.M.; Sanyal, S.K.; Brigham, W.E. (Stanford Univ., CA). Sep 1980.

From Meeting for DOE enhanced oil recovery project; San Francisco, CA, USA (22 Jul 1980).

First surfactant solutions of various concentrations mixed with varying amounts of salts and of crude oil were boiled at 100°C while nitrogen was bubbled through the solution. The height of the resulting foam texture were monitored for a week. The surfactants which passed this test were then tested at typical steam injection temperatures and pressures through a one-dimensional sand-pack in a tube furnace. The pack was saturated with the surfactant solution, subjected to the steam injection conditions and then nitrogen was injected from one end. The observed mobility of nitrogen and the breakthrough times were taken as criteria for permeability blocking. Nitrogen did form in-situ foam in the sandpack. Several surfactants showed orders of magnitude decline in mobility and increase in breakthrough time compared to the case when the pack was saturated with water. The process was repeated with the pack containing oil with irreducible water saturation. A slug of foamer followed by nitrogen was injected in the pack. The effect of slug size on permeability blocking was studied. Surfactants which passed these tests were subjected to steam injection conditions in pressure vessels under a nitrogen cushion for several weeks to test their longevity. Some surfactants showed rapid decrease in surfactant concentration and pH with time. Sand, crude oil and inorganic salts were added to the vessels to simulate field conditions. At least two surfactants passed all tests and showed a half life of several months under these conditions. 8 figures, 5 tables.

37610 (CONF-800750—, pp 161-183) **Foam as a mobility control agent in steam injection processes.** Chiang, J.C.; Sanyal, S.K.; Castanier, L.M.; Brigham, W.E.; Sufi, A. (Stanford Univ., CA). Sep 1980.

From Meeting for DOE enhanced oil recovery project; San Francisco, CA, USA (22 Jul 1980).

Laboratory studies showed that gravity override of injected gases in gas drive processes can be strikingly reduced, and hence recovery increased, by in-situ generation of foam. A two-dimensional, vertical Plexiglas model holding a sandpack was used to investigate this phenomenon. Saturation of the sandpack by a surfactant solution instead of pure water sharply increased liquid recovery and breakthrough time in nitrogen flooding process. The improvement in production was shown to be due to a reduction of gravity override caused by in-situ generation of foam at the gas-liquid interface. A large range of surfactant solutions of various concentrations with different amounts of monovalent and bivalent salts and alcohols has been studied as to their effectiveness as foamers. Surface tension, rate of drainage, bubble size and shape of the foams were measured in each case. In-situ foaming in the model increased generally with surfactant concentration until the critical micelle concentration (CMC) was reached; above CMC additional amounts of surfactant had very little effect on the phenomenon. Similar increase of recovery and delay in breakthrough time was observed in oil flooding processes. A slug of surfactant solution was injected into the pack saturated with oil, and water at irreducible water saturation, and then nitrogen was injected. Gravity override was much less than in the case when no surfactant was present. 15 figures.

37611 (CONF-800750—, pp 185-191) **Scaled physical models of steam drive operations.** Doscher, T.M.; Omoregie, O. (Univ. of Southern California, Los Angeles). Sep 1980.

From Meeting for DOE enhanced oil recovery project; San Francisco, CA, USA (22 Jul 1980).

The scaled physical model studies that have been conducted to study the effect of various parameters on the efficicncy of the steam drive have led to the hypothesis of the dual role of the injected steam: (1) as a heat transfer fluid that loses heat primarily by loss of its latent heat, and (2) as a dry gas that develops the required drag to displace the heated oil to and into the production well.

37612 (CONF-800750—, pp 193-221) **Surfactant adsorption on reservoir rocks at elevated temperatures.** Ziegler, V.M.; Handy, L.L. (Univ. of Southern California, Los Angeles). Sep 1980.

From Meeting for DOE enhanced oil recovery project; San Francisco, CA, USA (22 Jul 1980).

The effect of temperature on the adsorption of sulfonate surfactants and a nonionic surfactant onto crushed Berea sandstone was studied by both static and dynamic experiments. Static measurements were limited to 95°C or less, while dynamic experiments extended the temperature range to 180°C. Data were obtained for pure sodium dodecylbenzene sulfonate and for the commercial Witco TRS 10-80 sulfonate. They were precipitated at high temperatures by divalent cations despite efforts to minimize this problem by preflushes. Limited solubility manifested by a cloud point also affected the experiments with nonionics, but good data were obtained for this system. The nonionic surfactants are unsatable at elevated temperature. The results of adsorption experiments must be corrected for decomposition. The heat of adsorption of the nonionic surfactant, calculated from temperature variation of the equilibrium constant, was indicative of a hydrogen bonding mechanism for adsorption of this surfactant. 16 figures.

37613 (CONF-800750—, pp 223-237) **Temperature effects on low tension surfactant flood efficiency in consolidated sands.** Amabeoku, M.O.; Handy, L.L. (Univ. of Southern California, Los Angeles). Sep 1980.

From Meeting for DOE enhanced oil recovery project; San Francisco, CA, USA (22 Jul 1980).

Several flooding experiments have been performed with Berea sandstones that are 2 inches in diameter and 10 inches long. The surfactants studied to date are Witco TRS 10-80 and Petrostep 465, both of which are anionic. Surfactant concentration is 2.5 g/L in 10 g/L sodium chloride solution. Flood temperatures are 25°C, 82°C and 177°C. Core flood experiments include sequences wherein a core is flooded to residual oil saturation with hot water followed by surfactant to further displace oil that would otherwise not be recoverable without the lowering of the interfacial tension between the residual oil and injection fluid. Also reported are floods in which surfactant is used as the primary injection fluid so as to compare this mode of injection with other sequences. Recoveries observed range from 44% at room temperature to 93% of original oil in place at 350°F (177°C) with TRS 10-80 and from 55% to 98% with Petrostep 465. 7 figures.

37614 (CONF-800750—, pp 239-263) **Engineering economic model for appraisal of thermal recovery methods.** Williams, R.L.; Brown, S.L.; Ramey, H.J. Jr. (Stanford Univ., CA). Sep 1980.

From Meeting for DOE enhanced oil recovery project; San Francisco, CA, USA (22 Jul 1980).

This paper presents a method which estimates oil recovery by either continuous steam injection or in-situ combustion, and generates a cash flow estimate based on the production schedule of each process. The method uses lumped parameter models to allow for greater flexibility of input parameters and to be cost efficient when run on a computer. Reservoir parameters are assumed or obtained from conventional logging or laboratory methods. Once recovery rates for steam drive and in-situ combustion are obtained, a cash flow analysis may be made. Discounted cash flow is generated, based on a probability distribution of the oil price, fuel price, capital costs, and operating costs. Discounted net percent worth is graphed against injection rate of steam or compressed air, and an optimal injection rate can be determined. An indication of the preferred recovery method for a specific reservoir can then be obtained. 4 tables.

37615 (CONF-800750—, pp 269-282) **Potential for solar thermal enhanced oil recovery.** Elzinga, G. Sep 1980.

From Meeting for DOE enhanced oil recovery project; San Francisco, CA, USA (22 Jul 1980).

Objective was to determine if solar reflectors could be used to generate steam for enhanced oil recovery. A oil field like those in San Joaquin Valley was used as the design basis. A preliminary design was developed which uses solar collectors to heat feedwater to 250°F and capacity to store one day's use of hot water. Costs per million Btu were computed for troughs, dishes, and heliostat/central receivers for a 4.5 million Btu/h solar thermal system. Potential solar markets for industrial process market are discussed. (DLC)

37616 (CONF-800750—, pp 285-294) **Alkaline waterflooding demonstration project, Ranger Zone, Long Beach Unit, Wilmington**

Field California. Executive summary, fourth annual report, June 1979-May 1980. Carmichael, J.D. (City of Long Beach, CA); Mayer, E.H. Sep 1980.

From Meeting for DOE enhanced oil recovery project; San Francisco, CA, USA (22 Jul 1980).

Twenty-four entrainment alkaline core floods of preserved rock samples, completed during the year, gave discouraging results. Additional crude oil-water dehydration tests were made. Well operations are summarized. Preflushing was conducted. Pilot area performance and tertiary incentives are discussed. Future work planned is described. (DLC)

37617 (CONF-800750—, pp 295-326) **Micellar-polymer joint demonstration project, Wilmington Field, California. Executive summary, fourth annual report, June 1979-June 1980.** Staub, H.L. (City of Long Beach, CA). Sep 1980.

From Meeting for DOE enhanced oil recovery project; San Francisco, CA, USA (22 Jul 1980).

The micellar slug injection was initiated and completed; the polymer buffer was also injected. Except for Wells T-101 and T-102, the producing wells in the pilot area performed satisfactorily. The average oil production rate in the pilot area increased from 50 to 188 bbl/d over January to June, and the water-oil ratio dropped from 97 to less than 20 over the same period. Tracer tests and chemical monitoring were conducted. 13 figures, 6 tables. (DLC)

37618 (CONF-800750—, pp 327-340) **Microwave spectroscopic analysis of caustic waterflooding of heavy crude oil.** Brauer, P.; Wasan, D.T. (Illinois Inst. of Technology, Chicago). Sep 1980.

From Meeting for DOE enhanced oil recovery project; San Francisco, CA, USA (22 Jul 1980).

Microwave Absorption Spectroscopy was employed to monitor the dynamic in-situ oil saturation profiles during secondary and tertiary oil recovery of heavy crude in consolidate Berea cores. The alkaline flooding of the Wilmington field crude oil using both sodium hydroxide and sodium orthosilicate systems was investigated. We have examined both the entrapment and entrainment mechanisms in alkaline flooding tests using caustic solutions containing either no sodium chloride or 1% NaCl. In our core tests using NaOH with no salt, a gradual cleaning of the core and no oil banking phenomena were observed. Water-in-oil emulsions, as well as caustic breakthrough were observed coincidental with oil production. However, upon continuous injection of the same alkaline solution with 1% NaCl added, oil recovery improved. These results can be explained by our observations on the emulsion characteristics of crude oil-alkaline water formulations used and confirm our recent predictions. 4 figures, 2 tables.

37619 (CONF-800750—, pp 341-362) **Role of clays in enhanced recovery of petroleum. Annual report, FY 1979-1980.** Somerton, W.H.; Radke, C.J. (Univ. of California, Berkeley). Sep 1980.

From Meeting for DOE enhanced oil recovery project; San Francisco, CA, USA (22 Jul 1980).

This paper is a progress report on the work accomplished to date on California sands. Preliminary tests indicate that montmorillonites are probably the most common clay mineral present in California oil-producing formations. Although the amounts are small (1 to 2%), the large surface areas and the high reactivity of these surfaces have strong effects on chemical loss and flow characteristics of the formations. Fluid flow tests indicate that a release of fines and a decrease of permeability occur as fluid salinity decreases and alkalinity increases. Preliminary results and interpretations of the tests are presented in this paper.

37620 (CONF-800750—, pp 363-412) **Enhanced recovery with mobility and reactive tension agents.** Radke, C.J.; Somerton, W.H. (Univ. of California, Berkeley). Sep 1980.

From Meeting for DOE enhanced oil recovery project; San Francisco, CA, USA (22 Jul 1980).

An equilibrium chemical displacement model is presented. Calculations with the model reveal delayed and reduced tertiary oil recovery for adverse mobility ratios, and the critical importance of quantifying alkali rock interactions. Design of alkaline floods based only on properties of the fluid phases can be obviated by the paramount role of rock-chemical reactions. Significant improvement in tertiary oil production is found when mobility is controlled by polymers or flooding at higher temperatures. The interaction of caustic with Wilmington sands consists of a reversible sodium-hydrogen base exchange, a slow kinetic-controlled dissolution of siliceous mineral matter, and insoluble hydroxide formation due to reaction with exchanged hardness ions. Preliminary analysis of the dissolution of Wilmington cores by caustic suggests a reaction rate which is first order in hydroxide. A chromatographic ion-exchange theory is developed to describe simultaneous sodium-calcium base exchange with precipitation of calcium hydroxide. The most important finding from this theory is that alkaline preflushing with caustic to increase the efficiency of hardness ion removal does not appear promising. 18 figures.

37621 (CONF-800750—, pp 413-426) **Some applications derived from petroleum component properties for improved waterflooding studies.** Yen, T.F.; Chan, M.; Jang, L.K. (Univ. of Southern California, Los Angeles). Sep 1980.

From Meeting for DOE enhanced oil recovery project; San Francisco, CA, USA (22 Jul 1980).

This investigation examines the major fractions of natural crudes from three reservoirs where major field tests for caustic floods are currently in progress: Long Beach Oil Field (THUMS) (Ranger Zone), Huntington Beach Field (Aminoil) (Lower Main Zone), and Smackover Field (Phillips) (Nacatoch Formation). 5 figures, 2 tables.

37622 (CONF-800750—, pp 429-447) **Carbon dioxide for the recovery of crude oil.** Doscher, T.M.; El-Arabi, M.; Gharib, S.; Okekan, R.; Ardabilizadeh, R. (Univ. of Southern California, Los Angeles). Sep 1980.

From Meeting for DOE enhanced oil recovery project; San Francisco, CA, USA (22 Jul 1980).

Experiments were undertaken at pressures up to 3000 psia using both pure hydrocarbons and high gravity crude oils. Fluid velocities of 0.1 to 0.5 foot per day have been studied in a linear model of a uniform, nonreactive prototype. The results parallel those obtained earlier with low pressure scaled models using liquid solvents as the displacing phase. At high initial saturations of oil, the displacement by carbon dioxide pressures above 1000 psi is not too different than by water except for a continuing production of oil at high ratios of displacing agent to recovered oil. Gravity segregation of the carbon dioxide is the principal dynamic factor leading to the degradation of recovery. The injected carbon dioxide/produced oil ratios for continuous injection of one pore volume of carbon dioxide match field results. P.V.T. studies at sub-critical temperatures to date do not indicate that carbon dioxide and a high gravity, Appalachian crude oil are truly miscible at pressures up to 3000 psi. The dispersion coefficient at the interface is forced to extremely low values as a result of the high velocities and the increasing density of the displacing phase with pressure; as a result, the interface is stabilized. 12 figures.

37623 (DOE/BC/00050—16) **Determination of technology transfer requirements for enhanced oil recovery. Final report.** Wilson, T.D.; Scott, J.P. (Spears and Associates, Inc., Tulsa, OK (USA); Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Technology Center). Sep 1980. Contract AC19-78BC0050. 223p. NTIS, PC A10/MF A01.

A detailed field study was conducted to determine the technical information needs of current and potential users of enhanced oil recovery data. Under the direction of the Bartlesville Energy Technology Center (BETC), the study (1) identifies groups which have a need for EOR-related information, (2) delineate the specific information needs of each user-group, and (3) outlines methods for improved transfer of appropriate information to the end users. This study also assesses attitudes toward the EOR-related efforts of the US Department of Energy (DOE) and the BETC, and the role each should play in facilitating the commercialization of EOR processes. More than 300 users and potential users of EOR information were surveyed. Included in the survey sample were representatives of major oil companies, independent oil companies, engineering consulting firms, university and private research organizations, financial institutions and federal, state, and local policy-making bodies. In-depth questionnaires were specifically designed for each group. This study analyzes each group's position pertaining to (1) current level of EOR activity or interest, (2) current and projected EOR information needs, (3) assessments of the BETC's current information services and suggestions for improvement, (4) delineation of technical and economic constraints to increased EOR activity, and (5) steps the DOE might take to enhance the attractiveness of commercial EOR operations.

37624 (DOE/BC/10116—8) **Flow in porous media, phase behavior and ultralow interfacial tensions: mechanisms of enhanced petroleum recovery. Annual report, July 1978-July 1979.** Davis, H.T.; Scriven, L.E. (Minnesota Univ., Minneapolis (USA). Inst. of Tech.). Aug 1980. Contract AC19-79BC10116. 65p. NTIS, PC A04/MF A01.

Major thrusts of the Minnesota research program are to develop the molecular basis for understanding the origins of fluid microstructures and predicting their consequences, and to expose the experimental manifestations of such. The basic theory of fluid microstructures developed at Minnesota is outlined and some of the applications that have appeared during the past year are summarized. In trying to understand the distribution and flow of oil and brine in reservoir rock, it was discovered that concepts and results of a comparatively new physical theory fit porous media beautifully. The theory is the so-called percolation theory of transport along irregular networks and in irregular composites. The percolation theory, heretofore a subject concentrated in more abstract areas of theoretical science, can be amended and extended to explain and correlate most of the peculiarities of strength and transport in porous media -

mechanical properties, flow of fluids, response to radiation fields, and so on. The fundamentals should apply equally well whether the porous medium is reservoir rock or roasting potato, whether the flowing fluid of interest is crude oil or water vapor. The following topics are discussed: the origins of low tensions; semi-empirical models of interfacial tension; thermodynamics of microemulsions; theory of thin films, contact angle and wetting; nature of reservoir rock; relationship between pore features and residual non-wetting phase; and modeling chaotic composites.

37625 (ORNL—5665, pp 94-100) **Chemicals for enhanced oil recovery.** Jul 1980.

In Chemistry Division annual progress report, February 29, 1980.

Research reported in this section is aimed at lowering the cost of chemicals used in the micellar-flood technique for enhanced recovery of petroleum. Avenues explored include both search for cheaper methods of production and for cheaper raw materials, preferably from nonpetroleum sources. Research of some pertinence to oil recovery, but more fundamental in nature, is discussed in Section 3.3, 3.4, 3.5, and 6.5.1 of this report.

37626 Roles of liquid crystals and micelles in lowering interfacial tension. Franses, E.I.; Puig, J.E.; Talmon, Y.; Miller, W.G.; Scriven, L.E.; Davis, H.T. (Univ. of Minnesota, Minneapolis). *J. Phys. Chem.;* **84**: No. 12, 1547-1556(12 Jun 1980).

The phases present and the tension behavior of (i) a pure alkyl aryl sulfonate (sodium 8-phenyl-n-hexadecyl-p-sulfonate), (ii) its mixtures with sodium dodecyl sulfate, and (iii) a commercial petroleum sulfonate (Witco TRS 10-80) have been studied in aqueous sodium chloride and decane by a battery of techniques, including a newly developed fast-freeze cold-stage transmission electron microscopy technique. The pure sulfonate is only slightly soluble in water or brine in the temperature range 25 to 90°C and forms above the solubility limit a lamellar liquid crystalline phase. Lamellar liquid crystalline phases were also identified in aqueous dispersions of the commercial surfactant and in water-decane dispersions of the pure surfactant. A Kraft-like solubility boundary was observed near 50°C for the pure surfactant in decane. In the presence of small amounts of surfactant, oil-brine interfaces can exhibit ultralow tension. The body of data brought together in this paper lead to the conclusion that for the systems examined ultralow tensions are caused by the presence of a surfactant-rich third phase at the oil-brine interface. Micelles do not appear to induce low tensions. With commercial surfactant, oil-brine tension is known to have a minimum with respect to salt and to surfactant concentrationn; the same behavior is mimicked qualitatively by a mixture of the pure sulfonate (a liquid crystal former) and sodium dodecyl sulfate (a micelle former).

37627 Effect of salt on the structure of middle phase microemulsions using the spin-label technique. Ramachandran, C.; Vijayan, S.; Shah, D.O. (Univ. of Florida, Gainesville). *J. Phys. Chem.;* **84**: No. 12, 1561-1567(12 Jun 1980).

The middle phases obtained by varying the sodium chloride concentration in surfactant formulations containing 5:3 (wt/wt) TRS 10-410 (a petroleum sulfonate)-isobutyl alcohol and equal volumes of aqueous and oil phases were studied by using spin-labeling techniques. Two different spin-labels, one partially water soluble (5-doxylstearic acid label) and the other water insoluble (3-doxylcholestane label), were used. Extensive measurements of electrical conductivity and phase volumes of the middle phases were also carried out. These physical property results corroborated the spin-label studies in that below 2.0 wt % NaCl the middle phase was essentially a microemulsion of the water external type. Beyond 2.3% NaCl the appearance of a signal component typical of a free label (ketostearic acid) in an oil environment and changes in correlation time characteristics (cholestane label) coupled with physical property data underlined a qualitative change in the microemulsion system. It is believed that these changes are consistent with a transition from a water-external type to an oil-external type microemulsion system. This transition is estimated to be around 2 to 2.3% NaCl. The results are further substantiated by ascorbic acid reduction rate studies. Possible mechanisms of this transition are discussed.

37628 Evaluation of tangential filtration methods for the recovery of scleroglucans. Griffith, W.L.; Tanny, G.B.; Compere, A.L. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Dev. Ind. Microbiol.;* **20**: 743-750(1979).

Two methods of tangential filtration, axial filtration and cross-flow filtration, were tested on scleroglucal broths. These methods were compared to conventional straight-flow filtration using the same media with 5-μm pore size membranes. The axial filter at a differential pressure of 5 psi provided higher permeate fluxes after 6 min of filtration time and caused less polymer rejection by the membrane as measured by filtrate viscosity. Fluxes obtained using the axial filter fitted wth a 125-μm screen separated about 90% of the biomass from the diluted culture broth with no apparent polymer rejection as measured by filtrate viscosity. Both cross-flow and axial filtration methods gave higher fluxes after a 6-min filtration time than flat-plate filtration when used to polish the axial-flow screened filtrate using 5-μm membrane. At 5 psi differential pressure, less polymer rejection was observed with axial filtration of the prescreened feed than with the flat-plate filter. In addition to higher flux, tangential filtration methods produce a concentrated biomass stream which has the potential for use as an animal feed component.

PROCESSING

REFER ALSO TO CITATION(S) 37463, 38293

37629 Catalytic cracking process. Winter, W.E. (to Exxon Research and Engineering Co.). US Patent 4,172,812. 30 Oct 1979. Filed date 3 Apr 1978. 10p.

A specific object of the invention is to provide a process for producing a cat cracked naphtha which can be subsequently hydrorefined without significant loss of octane number. The process comprises recracking a cracked naphtha feed containing about 60% olefins (usually 20% to 40%), over a crystalline aluminosilicate zeolite catalyst to further crack the naphtha and to saturate at least 50% of the olefins, preferably 80% to 100% of the olefins. The cracked naphtha feed is contacted and reacted over the catalyst at temperatures ranging from 800° to 1100°F, and at pressures of zero to 50 psig. The reaction should produce significant saturation of the olefins, and hydrodenitrogenation and hydrodesulfurization of the cat naphtha feed. The reaction product should be a low sulfur gasoline suitable for addition to a gasoline blending pool. 15 claims.

PRODUCTS AND BY-PRODUCTS

REFER ALSO TO CITATION(S) 38293

HEALTH AND SAFETY

37630 Portable spotter for fluorescent contaminants on surfaces. Schuresko, D.D. (to Dept. of Energy). US Patent 4,200,801. 29 Apr 1980. Filed date 28 Mar 1979. 12p.

PAT-APPL-24,803.

A portable fluorescence-based spotter for polynuclear aromatic hydrocarbon contamination on personnel and work area surfaces under ambient lighting conditions is provided. This instrument employs beam modulation and phase sensitive detection for discriminating between fluorescence from organic materials from reflected background light and inorganic fluorescent material. The device uses excitation and emission filters to provide differentiation between classes of aromatic orgaic compounds. Certain inorganic fluorescent materials, including heavy metal compounds, may also be distinguished from the organic compounds, despite both having similar optical properties.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 37634, 38236

37631 (BNL—51216) **Long-range oil and gas forecasting methodologies: literature survey.** Cherniavsky, E.A. (Brookhaven National Lab., Upton, NY (USA). National Center for Analysis of Energy Systems). Aug 1980. Contract W-31-109-ENG-38. 26p. NTIS, PC A03/MF A01.

Performance of long-range energy system analyses requires the capability to project conventional domestic oil and gas supplies in the long term. The objective of the Long-range Forecasting Methodology project is to formulate an approach to this problem which will be compatible with the principal tool employed by the Energy Information Administration of the Department of Energy for long-range energy system analyses, the Long-term Energy Analysis Package (LEAP). This paper reports on projection methodologies that have appeared in the literature, evaluates them in terms of their applicability to the LEAP framework, and discusses the principal determinants of conventional domestic oil and gas supply in the long run.

37632 (DOE/PE/70024—01) **Economics and regulation of petroleum futures markets.** (Resource Planning Associates, Inc., Washington, DC (USA)). Aug 1980. Contract AC01-79PE70024. 87p. NTIS, PC A05/MF A01.

Because the futures market in petroleum products is a relatively recent phenomenon, the implications of public policies formulated for that market have not yet been fully explored. To provide the Office of Competition of the Department of Energy (DOE) with sufficient information to assess policy alternatives, Resource Plan-

ning Associates, Inc. (RPA) was asked to analyze the development of the futures market in No. 2 oil, assess the potential for futures markets in other petroleum products, and identify policy alternatives available to DOE. To perform this analysis, the criteria for a viable futures market was established first. Then, the experience to date with the 18-month-old futures market in No. 2 oil was examined, and the potential for viable futures markets in No. 6 oil, gasoline, jet fuel, and crude oil was assessed. Finally, how existing DOE regulations and prospective actions might affect petroleum futures market development was investigated.

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 38303

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 38084, 38857

37633 Oil spill retrieval system. Janson, J.J. (to Jan-Bar Retrieval Corp.). US Patent 4,178,247. 11 Dec 1979. Filed date 2 Aug 1978. 12p.

An oil spill retrieval system is described for retrieving spilled oil from the surface of a body of water and includes a boat having means for collecting the oil from the water surface. The system also includes means for reprocessing the collected oil and water collected with the oil to remove the aid from the water and to return the clean water to the body of water.

LEGISLATION AND REGULATION

REFER ALSO TO CITATION(S) 37632, 38229

TRANSPORT, PIPELINES, AND HANDLING

37634 Oil pipelines and public policy: analysis of proposal for industry reform and reorgnization. Mitchell, E.J. (ed.). Washington, DC; American Enterprise Inst. for Public Policy Research (1979). 403p. (CONF-7903139—).

From Oil pipelines and public policy conference; Washington, DC, USA (1 Mar 1979).

The papers presented at a conference sponsored by the American Enterprise Institute for Public Policy Research are published in this volume. An analysis of proposals for industry reform and reorganization of the pipeline industry is presented. Topics covered include: the case for divestiture; the pipeline undersizing argument and the record of access and expansion in the oil pipeline industry; the regulation of oil pipelines; and its effectiveness; appraising alternatives to regulation for natural monopolies; and pipelines and public policy supplements include: testimony given before the Senate Committee on Antitrust and Monopoly concerning oil company ownership of pipelines; Federal Energy Regulatory Commission statement on the treatment of certain production-related costs for natural gas to be sold and transported through the Alaska Natural Gas Transportation System; an analysis of the rates of return on petroleum pipeline investment; and the industrial structure of oil pipeline industry. (DMC)

37635 Maps of the oil and gas fields, natural gas pipelines, and oil pipelines of Pennsylvania. Lytle, W.S.; Balogh, L.J. (comps.). Harrisburg, PA; Department of Environmental Resources (1977). vp.

This map shows oil, natural gas, and gas storage fields and pools of Pennsylvania. It is based on 15-minute topographic bases. The most significant production of oil presently is from the Bradford field, which produced approximately 44% of Pennsylvania's crude oil production in 1976. Most of the oil comes from McKean, Venango, Warren, Forest, and Washington Counties. The county that currently produces the most natural gas is Indiana, but substantial amounts of gas are being produced in Armstrong, Clearfield, and Westmoreland Counties. The current largest gas storage field is Oakford in Westmoreland County; Leidy in Clinton County is next largest in size. Principal natural gas and crude oil and product pipelines are included. (DP)

PROPERTIES

REFER ALSO TO CITATION(S) 37621

STORAGE

37636 (SAND—80-1258) Chemistry and mineralogy of samples from the strategic petroleum reserve Bryan Mound site. Bild, R.W. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1980. Contract AC04-76DP00789. 56p. NTIS, PC A04/MF A01.

The goal of the Strategic Petroleum Reserve (SPR) program is to protect the United States from a temporary cutoff of imported crude oil by stockpiling a reserve of oil in caverns in Gulf Coast salt domes. Some suitable caverns already exist as a result of solution mining activities by commercial mining companies. Most of the caverns for the program, however, will be solution mined specifically for the SPR program. The tasks assigned to Sandia National Laboratories include conducting a geotechnical program and providing interim technical support for the leaching of the first five caverns in the Bryan Mound, Texas, salt dome. This report describes chemical, mineralogical and petrological work done at Sandia as of May 1, 1980 in support of Bryan Mound activities. Samples of Bryan Mound salt cores, sidewall samples and drill cuttings have been subjected to chemical, mineralogical and petrographic analysis. Halite (NaCl) was the major mineral in all samples with anhydrite ($CaSO_4$) a common accessory. Minor or trace sylvite (KCl) and quartz (SiO_2) were detected in some sidewall samples. Other minor minerals found in drill cuttings included quartz; mixed carbonates of Fe, Ca and Mg; and several iron oxides. Possibly the carbonates are reaction products with the basic drilling mud or possibly pieces of caprock which contaminated the cuttings. The iron oxides were probably produced by corrosion of the drill stem or bit. Densities of several core samples were determined and insoluble residue was counted for radioactivity.

37637 (SAND—80-1750) SPR geotechnical program preliminary long-term monitoring plan. Walker, H.C. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1980. Contract AC04-76DP00789. 27p. NTIS, PC A03/MF A01.

This preliminary plan defines the scope of the planned program. It also identifies the principal geotechnical parameters which should be monitored and the techniques which will be evaluated in the development of the long-term monitoring plan.

37638 (SAND—80-1904) Structural analysis of the West Hackbery No. 6 SPR storage cavern. Benzley, S.E. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1980. Contract AC04-76DP00789. 44p. NTIS, PC A03/MF A01.

Four separate structural analyses of the West Hackberry No. 6 SPR storage cavern are presented. One analysis covers the creep response of the cavern beginning shortly before the time when an accidental fire occurred and proceeding through the cavern recertification pressure test. The second analysis models the surface uplife that is expected during the same pressure test. The third and fourth numerical studies investigate the structural response of West Hackberry No. 6 to slabbing and a rapid pressure drop. All analyses indicate that this cavern should be structurally stable for the conditions assumed.

NATURAL GAS

REFER ALSO TO CITATION(S) 37929, 37931, 38289

RESERVES

REFER ALSO TO CITATION(S) 37916, 37926

37639 Potential new sources of natural gas. Schrider, L.A.; Wise, R.L. (US DOE). *J. Pet. Technol.*; **32**: No. 4, 703-716(Apr 1980).

The U.S. DOE (Department of Energy) is investigating several options for increasing the supply, including a program for unconventional gas recovery (UGR). Four UGR projects currently are being assessed: western tight gas sands, geopressured reservoirs, Devonian shales, and methane from coalbeds. Main emphasis of this article is on the effective recovery of natural gas from Devonian shale and methane from coalbeds. Upon completion of these projects, DOE expects the technology developed jointly with industry to result in wide-scale recovery and use of these new sources of natural gas. 28 refs.

GEOLOGY AND EXPLORATION

REFER ALSO TO CITATION(S) 37593, 37594, 37635, 37650, 37936, 37937, 37938, 37950, 37952, 37953, 37954, 38037

37640 (DOE/BC/10005—4) **Development of techniques for optimizing selection and completion of western tight gas sands. Tight gas sandstone channel continuity study, Fort Union-through Mesaverde Rocks, Greater Green River and Wind River Basins, Wyoming. Phase IV report, 1 August 1979-31 May 1980.** Hodges, L.T.; Knutson, C.F. (GeoEnergy Corp., Las Vegas, NV (USA)). Jun 1980. Contract AC08-79BC10005. 31p. NTIS, PC A03/MF A01.

To help find solutions to problems in obtaining gas production from channel sandstones in the Greater Green River Basin in Wyoming, we studied outcrops of equivalent rocks in three areas: Rock Springs Uplift, Hoback Basin, and Cretaceous Mountain. Formations studied were: Paleocene (Ft. Union equivalent), Hoback, Lance, Mesaverde (Hoback Basin), Ericson, and Rock Springs. Besides a photographic survey of channels in the areas, detailed measurements were made on 25 channels. About 80 structural elements (parallel inclined and trough cross beds) in each channel were measured for height and dip orientation. The most comprehensive data was obtained on the Rock Springs Formation.

DRILLING, PRODUCTION, AND PROCESSING

REFER ALSO TO CITATION(S) 37919, 37920, 38036, 38544

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 37647

37641 (PNL—3413) **Assessment of environmental health and safety issues associated with the commercialization of unconventional gas recovery: methane from coal seams.** Ethridge, L.J.; Cowan, C.E.; Riedel, E.F. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jul 1980. Contract AC06-76RL01830. 63p. NTIS, PC A04/MF A01.

Potential public health and safety problems and the potential environmental impacts from the recovery of gas from coalbeds are identified and examined. The technology of methane recovery is described and economic and legal barriers to production are discussed. (ACR)

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 37631, 38240

37642 (DOE/EIA—0145(79)) **Statistics of interstate natural gas pipeline companies: 1979.** Lyles, R.O.; Hinton, J.F. (Department of Energy, Washington, DC (USA). Energy Information Administration). Oct 1980. 268p. NTIS, PC A12/MF A01.

The 1979 financial and operating information of 89 Classes A and B interstate natural gas pipeline companies is presented in this volume with reported assets totaling $44.4 billion as of December 31, 1979, compared with the $39.0 billion on December 31, 1978. (Comparative data for 1978 are indicated in parentheses). Gross gas utility plant investments at the end of the year amounted to $33.0 billion ($30.4 billion); and net gas utility plant amounted to $17.9 billion ($16.5 billion). The Classes A and B Pipeline companies received total gas operating revenues of $35.5 billion ($26.0 billion) during the year 1979. This reflects the effect of inflation, of higher purchase gas cost, in addition to higher returns on equity capital needed to assure the financial integrity of the industry in the search for additional gas supplies. Sales of natural gas increased from 16.2 trillion cubic feet in 1978 to 17.7 trillion cubic feet in 1979. Sales of natural gas to ultimate consumers and to other gas utilities amounted to 2.8 trillion cubic feet (2.6 trillion cubic feet) and 14.8 trillion cubic feet (13.6 trillion cubic feet), respectively. Revenues from these sales amounted to $6.4 billion ($4.9 billion) and $27.6 billion ($20.0 billion), respectively. There was an average of 5,382,277 natural gas customers in 1979, compared with 5,181,895 in 1978. Of these averages, ultimate consumers numbered 5,379,270 (5,179,233) and 3007 (2662) wholesale gas utility customers. The collection of financial and operating statistics on the natural gas industry that is reported here is limited under the Natural Gas Act to that segment of the industry which is subject to the Commission's regulatory jurisdiction.

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 37790, 38036

ENVIRONMENTAL EFFECTS

REFER ALSO TO CITATION(S) 37641

37643 (FERC/EIS—0018) **Trailblazer Pipeline System final environmental impact statement.** (Federal Energy Regulatory Commission, Washington, DC (USA). Office of Pipeline and Producer Regulation). Sep 1980. 418p. NTIS, PC A18/MF A01.

This Final Environmental Impact Statement (FEIS), arises from applications for a certificate of public convenience and necessity authorizing, pursuant to section 7(c) of the Natural Gas Act, the construction and operation of facilities to transport natural gas from the Rocky Mountain area to markets in that area, the east, and midwest. Facilities would consist of approximately 797 miles of 36-inch and 12 miles of 24-inch diameter pipeline and 28,700 horsepower of compression. The FEIS assesses the environmental impact of the proposed project, a modification of the project design, several alternative routings, and the use of existing systems modified as necessary to transport similar volumes of gas. It also assesses the primary impact of nonjurisdictional gas conditioning facilities needed to provide some of the gas necessary for this project. Potential effects on land use, vegetation, soils, wildlife, water, air quality, noise levels, geology, cultural resources, and socioeconomic conditions were examined. Based on its examination, the staff concludes that this project would have limited adverse environmental impact. Subject to a determination of the specific facilities required to transport the actual gas supply, no long-term or irreparable impact would result from the approval of this project, providing the alternatives and conditions recommended by the environmental staff in section E of the FEIS are adopted. It was concluded that: (1) the Arapahoe Alternative is superior to the Trailblazer Segment; (2) the MAPC Alternative is superior to a portion of the Overthrust Segment; (3) a 42-inch diameter pipeline should be installed with no compression; or (4) compression should be added to the 36-inch diameter system only if necessary, as determined by the quantity of gas expected from this area.

ARTIFICIAL STIMULATION

37644 (DOE/BC/10003—11) **Western gas sands project. Status report, 1 June-30 June 1980.** (CER Corp., Las Vegas, NV (USA)). 1980. Contract AC08-79BC10003. 68p. NTIS, PC A04/MF A01.

Progress of the government-sponsored projects during June 1980, that are directed towards increasing gas production from the low permeability gas sands of the western United States, is summarized. Northwest Exploration declined use of their site for the multi-well experiment; additional sites are being contemplated. Experiments began at Bartlesville Energy Technology Center designed to examine fracture closure and crushing strength of bauxite. At Lawrence Livermore Laboratory, work is progressing on the code to calculate fluid motion in an expanding propagation crack.

37645 (DOE/BC/10003—12) **Western gas sands project. Quarterly basin activities report, April 1-June 30, 1980.** (CER Corp., Las Vegas, NV (USA)). 1980. Contract AC08-79BC10003. 37p. NTIS, PC A03/MF A01.

This report is a summary of drilling and testing operations in the four primary study areas of the WESP for this period. Greater Green River Basin, Northern Great Plains Province, Piceance Basin, and Uinta Basin. (DLC)

37646 (SAND—80-0591) **Gas Research Institute improved fracturing. Unconventional natural gas program, eastern devonian shales diagnostic program: Black No. 1 well experiment results. Third quarterly report, October 1979-December 1979.** Schuster, C.L. (ed.). (Sandia National Labs., Albuquerque, NM (USA)). Feb 1980. Contract AC04-76DP00789. 23p. NTIS, PC A02/MF A01.

During the last quarter of 1979, Sandia National Laboratories participated in an experiment with Thurlow Weed and Associates and the Morgantown Energy Technology Center. This Devonian Shale gas stimulation experiment was conducted in an area north of Columbus, Ohio. One purpose of the experiment was to apply the diagnostic instrumentation that is available for fracture mapping and characterization to increase our understanding of the stimulation technique. The induced fracture apparently followed a pre-existing fracture vertically from the borehole with an orientation of the N 62° E and in the latter stages of the stimulation turned into a shallower horizontal fracture. This fracture behavior was confirmed by several diagnostic analyses and demonstrates the insight that can be gained by fully instrumented stimulation experiments.

LEGISLATION AND REGULATION

REFER ALSO TO CITATION(S) 38229

TRANSPORT, PIPELINES, AND HANDLING

REFER ALSO TO CITATION(S) 37635, 38286, 38542

37647 (PNL—3308) **Assessment of the risk of transporting propane by truck and train.** Geffen, C.A. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Mar 1980. Contract AC06-76RL01830. 211p. NTIS, PC A10/MF A01.

The risk of shipping propane is discussed and the risk assessment methodology is summarized. The risk assessment model has been constructed as a series of separate analysis steps to allow the risk to be readily reevaluated as additional data becomes available or as postulated system characteristics change. The transportation system and accident environment, the responses of the shipping system to forces in transportation accidents, and release sequences are evaluated to determine both the likelihood and possible consequences of a release. Supportive data and analyses are given in the appendices. The risk assessment results are related to the year 1985 to allow a comparison with other reports in this series. Based on the information presented, accidents involving tank truck shipments of propane will be expected to occur at a rate of 320 every year; accidents involving bobtails would be expected at a rate of 250 every year. Train accidents involving propane shipments would be expected to occur at a rate of about 60 every year. A release of any amount of material from propane trucks, under both normal transportation and transport accident conditions, is to be expected at a rate of about 110 per year. Releases from propane rail tank cars would occur about 40 tines a year. However, only those releases that occur during a transportation accident or involve a major tank defect will include sufficient propane to present the potential for danger to the public. These significant releases can be expected at the lower rate of about fourteen events per year for truck transport and about one event every two years for rail tank car transport. The estimated number of public fatalities resulting from these significant releases in 1985 is fifteen. About eleven fatalities per year result from tank truck operation, and approximately half a death per year stems from the movement of propane in rail tank cars.

PROPERTIES

REFER ALSO TO CITATION(S) 37942, 37943, 38494

OIL SHALES AND TAR SANDS

SITE GEOLOGY AND HYDROLOGY

SITE GEOLOGY

37648 (DOE/METC/10866—21) **Stratigraphy of the Devonian Chattanooga and Ohio shales and equivalents in the Appalachian basin: an example of long-range subsurface correlation using gamma-ray logs.** Roen, J.B. (Geological Survey, Reston, VA (USA)). 1980. Contract AI21-79MC10866. 30p. NTIS, PC A03/MF A01.

The correlations discussed demonstrate the utility of the gamma-ray 'og for regional, basinwide stratigraphic studies. Through the use of these logs, suggested correlations based on paleontologic evidence (Hass, 1956) were confirmed and new correlations were established in the Appalachian basin across at least 700 miles. These logs used in conjunction with a few lithologic logs and gamma-ray profiles of surface sections (Ettensohn and others, 1979) have proven to be a useful tool for long-range stratigraphic studies.

37649 (FE—2346-80) **Stratigraphy of the Upper Devonian-Lower Mississipppian of Michigan.** Fisher, J.H. (Michigan State Univ., East Lansing (USA). Dept. of Geology). Aug 1980. Contract AC20-76LC10153. 174p. NTIS, PC A08/MF A01.

A stratigraphic inventory was made of the Devonian-Mississippian black shales of Michigan for their possible future use as a source of oil or gas. Structure, contour and isopach maps were made to scales of 1/1,000,000 and 1/250,000. Lithofacies maps were constructed on the 1/1,000,000 scale. An east-west cross-section of central Michigan is included. A portion of eastern Michigan was mapped at the 1/250,000 scale to show bedrock topography, bedrock cover, and drilling depths to the Antrim. All structure, contour and isopach maps were contoured by computer. The remainder were drawn by hand. The major stratigraphic conclusions are: (1) a minor unconformity is probably present at the top of the Traverse limestone in western Michigan; (2) the Traverse shale has closer affinities to the overlying Antrim than it does to the Traverse limestone; and (3) the Antrim should probably be divided into an upper and lower Antrim with a tongue of Ellsworth shale coming in from the west to divide the Antrim.

37650 (ORNL/SUB—75/87989) **Preliminary regional study of the present and possible future oil and gas development in the areas of thick rock salt and shale deposits of Michigan, Ohio, Pennsylvania, and western New York as of December 1975.** (Netherland, Sewell and Associates, Inc., Dallas, TX (USA)). Dec 1975. Contract W-7405-ENG-26. 43p. NTIS, PC A03/MF A01.

The objective of this study was to make a preliminary investigation of those areas of the Michigan basin and the Ohio-Pennsylvania-western New York portion of the Appalachian basin which are underlain by thick beds of rock salt and certain shale deposits for the over-all purpose of locating general areas where present and/or possible future oil and gas development would not interfere with the possible storage of radioactive waste material in the thick beds of salt or shale deposits underlying these areas. Some of the more pertinent factors included in our investigation were: (1) the location of the present oil and gas fields in the areas of interest; (2) the general geology, including structure, stratigraphy, and general thickness of the sediments above and below the thick salt beds and shale deposits; (3) the trends indicated by past and present oil and gas development as well as the indicated trends of possible future oil and gas development throughout the areas of interest; (4) the density and depth of holes drilled, either successful or unsuccessful, in the search for oil and gas and the effect which these holes might have on the use of the thick beds of salt and shale deposits as possible storage sites for radioactive waste material; and (5) the general areas where the past, present and/or possible future oil and gas development would not interfere with the possible storage of radioactive waste in such salt beds and shale deposits underlying the major portion of the Michigan basin and that portion of the Appalachian basin found in Ohio, Pennsylvania and western New York.

37651 **Compositional variation of retorted shale oils with stratigraphy: Wyoming core, northern Green River Basin.** Jackson, L.P.; Morandi, J.R.; Poulson, R.E. (Energy Research and Development Administration, Laramie, WY). pp 267-284 of Oil sands and oil shale. Strausz, O.P. (ed.). New York, NY; Verlag Chemie (1978).

A series of oils produced by Fischer assay of a core representing 11 major strata of northern Green River Basin-Green River Formation oil shale have been analyzed for physical and chemical properties. Conclusions are that shale from these different strata can be handled and processed in the same way, requiring no unique environmental control technology. Total elemental analysis reveals no significant variations between strata and no potentially harmful elements in unusual concentration. 1 figure, 7 tables.

DRILLING, FRACTURING, AND MINING

REFER ALSO TO CITATION(S) 37654, 37658

37652 (FE—2346-90) **Seismic investigations of Antrim shale fracturing: vertical seismic profiling field work.** Turpening, R.M.; Liskow, A.; Thomson, F.J. (Dow Chemical Co., Midland, MI (USA)). Sep 1980. Contract AC01-76ET12153. 40p. NTIS, PC A03/MF A01.

Through the use of surface to downhole shear- and compressional-wave seismic techniques, the subsurface structure through the Antrim shale was studied in Sanilac County, Michigan. This report summarizes the field work, the field instrumentation and the data collection associated with this work.

OIL PRODUCTION, RECOVERY, AND REFINING

REFER ALSO TO CITATION(S) 37461

IN SITU METHODS, TRUE AND MODIFIED

REFER ALSO TO CITATION(S) 37651, 37664, 37665

37653 (FE—2346-70) **Energy from true in situ processing of antrim shale: process control and data collection.** Frost, J.R.; Pihlaja, R.K. (Dow Chemical Co., Midland, MI (USA). Process Development Dept.). Jul 1980. Contract AC20-76LC10153. 66p. (DOW/SR—70). NTIS, PC A04/MF A01.

This report describes the process control and ancillary operating equipment used at the Antrim shale in situ field extraction trials. A method of flame detection for well heaters is described. An automated method of data logging procedures, final data collection method, and data reduction procedures used during these trials is presented.

37654 (FE—2346-94) **Investigation of the feasibility of recovering energy from Antrim oil shale by an in situ process. Final summary report.** Young, D.C. (Dow Chemical Co., Midland, MI (USA).

Process Development Dept.). Sep 1980. Contract AC20-76LC10153. 35p. NTIS, PC A03/MF A01.

This report briefly summarizes the results of a four-year study which consisted of four tasks: shale characterization; in-situ fracturing and assessment; in situ extraction trails; and environmental, public policy and legal assessment. Forty one topical reports issued during the project are listed. A wealth of data has been published on the chemical, physical, geological, mineralogical and lithological properties of Antrim shale. Large numbers of stratigraphic cross sections and maps have been prepared. Much was learned in the fracturing experiments and extraction trials. Antrim shale was successfully ignited in situ in an explosively fractured site and low BTU gas was produced. However, as the formation was heated up the permeability decreased, and significant self sustained combustion was not achieved before work had to be discontinued. No significant impacts on the environment other than surface disturbance were observed.

37655 (LA—8513-MS) **Economics of the dry combustion process for tar sand oil recovery.** Barrett, R.J. (Los Alamos Scientific Lab., NM (USA)). Aug 1980. Contract W-7405-ENG-36. 30p. NTIS, PC A03/MF A01.

An economic evaluation of the dry combustion process for tar sand oil recovery is presented. Assumptions concerning economic variables, reservoir characteristics, and process performance are clearly defined and justified. Assuming a level of process performance better than has been achieved to date in field tests, the cost of the recovery process alone was calculated at $25.20/bbl. Most of the process cost (78%) results from purchasing and operating the air compressors. Consequently, a program of applied research to reduce compressor costs could greatly improve the process economics. Most of the remaining process cost (18%) results from well completion. Only 27% of process cost is related to capital expenditures. Thus, the cost is not very sensitive to the assumed rate of return on investment. Cost is highly sensitive to two process parameters: fractional oil recovery and compressed air requirement. Assumed values for both variables are optimistic compared with the current state of technology. Future field tests should concentrate on increasing oil recovery and reducing air requirements. Cost is also highly sensitive to the recovery pattern area. Cost is very sensitive to oil concentration. Sensitivity to other reservoir characteristics, such as pay thickness, was not calculated because their effect on process performance is not well understood. Research toward understanding these phenomena would help clarify the economics of dry combustion. When taxes, royalties, and exploration costs are included, the calculated crude oil price is $39.05/bbl.

37656 (SAND—80-0916) **FY 80 Tar Sands program. Second quarterly report, April 1980.** Wayland, J.R.; Fox, R.L. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1980. Contract AC04-76DP00789. 21p. NTIS, PC A02/MF A01.

The research and development efforts in support of the Tar Sands program reservoir access and alternate extraction activities that were initiated last quarter have been continued and expanded. The development of a short course on the utilization of specialized drilling technology to Tar Sands has been investigated. The steam quality sampler is undergoing laboratory testing. Plans for a Tar Sands enhanced permeability workshop have been initiated. A special report on possible application of sand control methods to the Tar Sands steam injection test (TS-1S) experiment has been prepared. The first stage of the analysis of rf and microwave heating has been completed. The results of a series of laboratory experiments on in-situ hydrogenation are presented.

SURFACE METHODS

37657 (DOE/ET/14103—T.3.0) **Scale-up and size justification of operations, systems and equipment for a commercial-scale Paraho oil shale module: Task 3. For the period: 15 June 1980-30 September 1980.** Evin, C.G. (ed.). (Standard Oil Co., Cleveland, OH (USA)). 1980. Contract FC03-80ET14103. 93p. NTIS, PC A05/MF A01.

The capacity of equipment and systems utilized for the operation of the Paraho semi-works retort at Anvil Points, Colorado is reviewed and compared to the proposed commercial-scale Paraho retort module. Scale-up and replication of equipment is considered from the criteria of commercial availability.

37658 (PB—80-122591) **Fugitive dust at the Paraho oil shale demonstration retort and mine. Final report, Aug-Nov 1977.** Cotter, J.E.; Powell, D.J.; Habenicht, C. (TRW Environmental Engineering Div., Redondo Beach, CA (USA)). Oct 1979. Contract EPA-68-03-2560. 89p. NTIS, PC A05/MF A01.

A fugitive dust sampling program was conducted at Anvil Points, Colorado, site of the Paraho mining and oil shale retorting operations. High-volume samplers were used extensively for fugitive dust collection, and 175 total suspended particulate calculations are reported for measurements made at the mine adits, the haul road, raw shale crushing area, and the spent shale transfer area. Supporting meteorological data is also given as well as background dust measurements. Particulate size distribution calculations were derived from 36 cascade impactor samples at the above locations. Elemental chemical analysis results are reported for eighteen elements from each of twenty selected high-volume sampler collections. In addition, twenty-six samples were extracted for organic content. The extractions were then fractionated by the EPA/IERL Level 1 method, and eight organic classification fractions are quantitatively given. The significance of these findings is summarized, and recommendations for work are stated.

37659 (UCID—18805) **RSTAT: the computer code system to predict oil shale retort performance.** Libicki, S.B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Sep 1980. Contract W-7405-ENG-48. 34p. NTIS, PC A03/MF A01.

Algorithms have been developed which predict shale retort performance based on offgas composition and production. These algorithms include predictions of retorting rate, quantity of shale processed, maximum oil combustion and estimated oil combustion which have been combined in one subroutine RSTAT. This subroutine uses an input array consisting of offgas volume percents, inlet nitrogen quantity since the last call to the subroutine and time into experiment, and returns an output array consisting of predictions for shale processed, retorting rate, oil production, and percent oil yield (by three independent methods). The code also calculates cumulative production and production rate of most measured offgas species.

PURIFICATION

REFER ALSO TO CITATION(S) 37463

PROPERTIES AND COMPOSITION

REFER ALSO TO CITATION(S) 38349

37660 (FE—2346-89) **Chemical composition of Antrim shale in the Michigan basin.** Leddy, D.G.; Sandel, V.R.; Swartz, G.L.; Kenny, D.H.; Gulick, W.M.; El Khadem, H.S. (Michigan Technological Univ., Houghton (USA). Dept. of Chemistry and Chemical Engineering; Dow Chemical Co., Midland, MI (USA)). Aug 1980. Contract AC20-76LC10153. 235p. NTIS, PC A11/MF A01.

During the period between March 1977 and July 1980 core samples from 28 different wells at various locations in the Antrim shale deposit in the Michigan Basin were analyzed for Al, SiO_2, Fe, Mg, Ca, Na, S, Pb, Hg, Ba, Sb, Sn, Cd, Ag, Mo, Sr, Br, As, Zn, Cu, Ni, Co, Mn, Cr, V, Sc, Cl, P, F, B, Be, and Li. The geochemical analysis revealed that the sulfur content of the shale varied proportionately with that of carbon. On the other hand, calcium values vary inversely with organic carbon (lowest calcite in shale with highest organic carbon). Iron values do not vary greatly within a core and show no tendency to follow organic carbon or sulfur. It seems that the relationships that exist between the chemical species are controlled by the geological events that resulted in the formation of the shale. The kerogen was found to be a crosslinked polymeric structure consisting of roughly equal amounts of aromatic and aliphatic carbons. Functional groups are few, mainly hydroxy and olefinic double bonds. The bitumen (toluene extractable material) was fractionated and the fractions identified. The paraffins in the samples had the same constituents in differing concentrations while the aromatic fractions appear to have significant differences in composition. The distribution of the n-alkanes indicates the shale is more mature than the Green River shales. The amount of vanadyl porphyrin is greater than the amount of nickel and the ratio increases with depth. The concentration of petroporphyrins ranged from one-tenth to one-third the amount extracted from western oil shales.

37661 **High performance liquid chromatographic separation of olefin, saturate, and aromatic hydrocarbons in high-boiling distillates and residues of shale oil.** McKay, J.F.; Latham, D.R. (Dept. of Energy, Laramie, WY). *Anal. Chem.;* **52**: No. 11, 1618-1621(Sep 1980).

A high performance liquid chromatography method has been developed for the separation of olefin, saturate, and aromatic hydrocarbons found in high-boiling distillates and residues of shale oil and in whole shale oils. The dual-column chromatographic system uses silica gel in one column and silica gel coated with silver nitrate in a second column. Separated fractions are analyzed by infrared and carbon-13 nuclear magnetic resonance spectrometry to demonstrate the validity of the separation. The time required for a separation is about 2 h. The separations are repeatable, and recovery of material after separation is generally better than 80%. The olefin, saturate, and aromatic fractions obtained from a separation are suitable for further analysis.

37662 **Determination of individual organic compounds in shale oil.** Hertz, H.S.; Brown, J.M.; Chesler,S.N.; Guenther, F.R.; Hilpert, L.R.; May, W.E.; Parris, R.M.; Wise, S.A. (National Bureau of

Standards, Washington, DC). *Anal. Chem.;* **52**: No. 11, 1650-1657(Sep 1980).

Several techniques have been investigated for quantitating individual organic compounds in shale oil. Acid-base extraction and high performance liquid chromatography were emphasized as independent methods of shale oil fractionation. Gas chromatography, gas chromatography-mass spectrometry, and high performance liquid chromatography were used for individual compound quantitation utilizing external and/or internal standards or standard addition techniques. The following compounds were measured in the shale oil: pyrene, fluoranthene, benzo[e]pyrene, benzo[a]pyrene, phenol, o-cresol, acridine, and 2,4,6-trimethylpyridine. Comparable results were obtained by the various methods for extraction and quantitation.

37663 Separation of benzo(f)quinoline and phenanthridine from shale oil and characterization by room temperature phosphorescence. Ford, C.D.; Hurtubise, R.J. (Univ. of Wyoming, Laramie). Contract DE-A520-79-LC01761. *Anal. Lett.;* **13**: No. A6, 485-496(1980).

A method for the separation of benzo(f)quinoline (BfQ) and phenanthridine (PH) in shale oil employing a combination of column and high performance liquid chromatography (HPLC) is described. Room temperature phosphorescence (RTP), excitation and emission spectra, fluorescence emission spectra, and chromatographic data were used for identification of the compounds. 6 figures.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 37630, 37658, 37666

WASTE RESEARCH AND MANAGEMENT

37664 (DOE/LC/10020—T1) **Hot gas stripping of ammonia and carbon dioxide from simulated and actual in situ retort waters.** Murphy, C.L. (Colorado School of Mines, Golden (USA)). 1979. Contract AC20-79LC10020. 300p. NTIS, PC A13/MF A01.

This study proved that ammonia and carbon dioxide could be removed from retort water by hot gas stripping and that overall transfer rates were slower than for physical desorption alone. The ammonia in solution complexed with the carbonate species with the result that the CO_2 transfer rates were linked to the relatively slower desorption of NH_3 from solution. Ionic reactions in the liquid phase limited the quantity of free NH_3 and CO_2, thus decreasing the driving forces for mass transfer. The retort water exhibited foaming tendencies that affected the interfacial area which should be taken into account if a stripping tower is considered on a larger scale. Transfer unit heights were calculated for the process conditions studied and correlated such that scaleup to increased capacities is possible.

37665 Preliminary examination of waste waters produced during an in situ retorting of tar sands. Barbour, F.A.; Guffey, F.D.; Dorrence, S.M. (Laramie Energy Research Center, WY). *Oil Sands;* 743-748(1977).

A study of retort waters produced during an in situ reverse burn of a tar sand deposit near Vernal, Utah is presented. Analysis of the organic constituents by standard methods as well as spark source mass spectroscopy showed ammonium, sulfate, and chloride to be the predominant ions. Organic material isolated from the produced water ranged from 16 to 25 grams per liter. The major organic components were identified by means of combined gas chromatography-mass spectroscopy. Of these, carboxylic acids, particularly acetic acid, were found to be the most abundant. Phenols and lactones were also identified. The organic and inorganic components identified in the tar sands product water are compared with the corresponding materials found in the product water from the in situ recovery of oil shale. 5 figures, 8 tables.

ENVIROMENTAL ASPECTS

37666 (DOE/RA/50211—T1) **Current environmental, health, safety, and socioeconomic research activities related to oil shale: draft.** (TRW, Inc., McLean, VA (USA). Energy Systems Group). Sep 1980. Contract AC01-80RA50211. 37p. NTIS, PC A03/MF A01.

This document was prepared for DOE Resource Applications. It provides a compilation of information on current environmental, health, safety and socioeconomic research activities related to oil shale. The information is the most recent available through August 29, 1980. Included are the following: (1) project title; (2) adminstering agency; (3) contractor; (4) project status; (5) funding level; (6) project schedule; (7) deliverable; and (8) key personnel. The data contained in these reports can be used in environmental impact analyses relating oil shale to various incentives given in the Alternative Fuels Bill. The information provided was obtained from computer search printouts, review of respective agency documents and communication with agency personnel. A complete list of references is provided. The sponsoring organizations include the Department of Energy, the Environmental Protection Agency, the Department of Agriculture, and the Department of Interior.

37667 (PB—80-128739) **Underground disposal of retorted oil shale for the Paraho retorting process. Open file report, Jul 1976-May 1978.** Earnest, H.W.; Heisler, R.A.; Hoe, H.L.; Rajaram, V. (Cleveland-Cliffs Iron Co., Rifle, CO (USA). Western Div.). May 1978. Contract J0265052. 379p. NTIS, PC A17/MF A01.

This report covers the results of a two-phase study to determine the feasibility of underground disposal of retorted oil shale. Two mining methods, chamber and pillar mining and sublevel stoping, were specified for backfilling. Phase I of the study covered the evaluation of hydraulic, mechanical, and pneumatic transport and stowing systems, individually and in various combinations, and the selection of the most feasible methods. Conveyor transport and stowing and a combination conveyor transport and stowing with pneumatic topfilling were selected for detailed study of phase II. Phase II activities included detailed engineering analysis and design of the selected systems, an engineering economic analysis, and a cost comparison with total surface disposal of retorted oil shale. An extensive literature search was conducted and the bibliography is included in the report.

NUCLEAR FUELS

RESERVES

37668 (GJO—111(80)) **Assessment report on uranium in the United States of America.** (Department of Energy, Grand Junction, CO (USA). Grand Junction Office). Oct 1980. 160p. PC E05/MF $3.50.

Assessment of the uranium resources in the United States as of October 1, 1980, indicates a range of reserves, in mean values, from 645 thousand tons of U_3O_8 (in the $30 per pound of U_3O_8 cost category) to 1.122 million tons (in the $100 per pound of U_3O_8 category). Ranges of potential resources are also shown for the same cost categories: from 885 thousand to over 2 million tons of U_3O_8 in the probable class; 346 thousand to over 1 million tons in the possible class; and 311 thousand to nearly 700 thousand tons in the speculative class. There are an estimated 140 thousand tons of U_3O_8 that could be recovered as a byproduct of phosphate and copper mining through the year 2009. Production capability studies indicate that the demand could be satisfied from currently estimated resources if there is a transition from current production of lower cost resources to production from the $50 per pound of U_3O_8 resources by the mid 1990s. If, due to foreign competition or other market forces, production incentives are not maintained, domestic production potential will not be realized, and the United States could become dependent on foreign sources for much of its U_3O_8.

37669 Uranium resource/technology seminar 2, 1979. Golden, CO; Colorado School of Mines (1979). 421p. (CONF-7903140—).

From Uranium resource technology seminar; Golden, CO, USA (12 Mar 1979).

This conference proceedings contains 20 papers, all of which are indexed separately. Some of the subjects covered are nuclear power and mining needs to the year 2000; uranium in ground water; processing marginal reserves; uranium recovery from phosphoric acid; site selection for disposal facilities; economics; solution mining processes; and current legislation.

EXPLORATION

37670 (GJBX—114(80)) **Evaluation of selected geochemical anomalies in Colorado and the Southeastern US. Final report.** Carpenter, R.H. (Bendix Field Engineering Corp., Grand Junction, CO (USA)). Aug 1980. Contract AC13-76GJ01664. 75p. NTIS, PC A04/MF A01.

This study demonstrates the utility of HSSR geochemical data from stream sediment in exploration for uranium. In the southeastern US, four uraniferous occurrences and associated radiometric anomalies were identified in areas where uranium mineralization has not been previously reported. At two localities, assays of about .01% have been obtained from saprolite. There is some evidence which suggests that uranium may have been leached at these localities and that higher grades of U are likely at depth.

37671 (GJBX—125(80)) **Engineering report on drilling in the Sand Wash Basin, Colorado.** Callihan, M.C. (Bendix Field Engineering Corp., Grand Junction, CO (USA)). Jan 1980. Contract AC13-76GJ01664. 90p. NTIS, PC A05/MF A01.

The Sand Wash Basin Drilling project was conducted by Bendix Field Engineering Corporation in support of the US Department of Energy (DOE) National Uranium Resource Evaluation (NURE) program. This project consisted of 27 drill holes ranging in depth from 110 feet (33.5 m) to 1,995 feet (608.1 m). A total of 25,514 feet (7,471.9 m) was rotary drilled, and 1,593.5 feet (485.7 m) were cored resulting in a total of 26,107.5 feet (7,957.6 m) drilled for the project. The objective of the project was to provide comprehensive subsurface geologic data relevant to uranium mineralization. This was accomplished by drilling in major outcrop areas of the Browns Park Formation in Moffat and Routt Counties, Colorado. The project began May 18, 1979; drilling was completed November 4, 1979. Most site restoration and cleanup was completed during the fall of 1979 with the remainder to be completed during the spring of 1980.

37672 (GJBX—168(80)) **Aerial radiometric and magnetic survey, San Angelo National Topographic Map: Texas, West Texas Project. Final report.** (Geodata International, Inc., Dallas, TX (USA)). May 1980. Contract AC13-76GJ01664. 294p. NTIS, PC E11/MF $4.50.

The results of analyses of the airborne gamma radiation and total magnetic field survey flown for the region identified as the San Angelo National Topographic Map NH14-1 are presented. The airborne data gathered are reduced by ground computer facilities to yield profile plots of the basic uranium, thorium, and potassium equivalent gamma radiation intensities, ratios of these intensities, aircraft altitude above the earth's surface, total gamma ray and earth's magnetic field intensity, correlated as a function of geologic units. The distribution of data within each geologic unit, for all surveyed map lines and tie lines, has been calculated and is included. Two sets of profiled data for each line are included, with one set displaying the above-cited data. The second set includes only flight line magnetic field, temperature, pressure, altitude data plus magnetic field data as measured at a base station. A general description of the area, including descriptions of the various geologic units and the corresponding airborne data, is included.

37673 (GJBX—177(80)) **Principles and characteristics of surface radon and helium techniques used in uranium exploration.** Pacer, J.C.; Czarnecki, R.F. (Bendix Field Engineering Corp., Grand Junction, CO (USA)). Sep 1980. Contract AC13-76GJ01664. 72p. NTIS, PC A04/MF A01.

Studies were carried out to determine the nature of some of the surface radon and helium techniques used for uranium exploration. By performing radon and helium measurements at three sites with differing geology and accessibility, we were able to examine the constraints on the features determined. The sites are the Red Desert in south central Wyoming, Copper Mountain in central Wyoming, and Spokane Mountain in eastern Washington. The radon techniques employed were: zinc sulfide detectors, an ionization chamber, alpha track detectors, thermoluminescence detectors, charcoal canisters, and the partial extraction of lead-210 from soil samples. Helium was measured in soil-gas samples, soil gas from collectors, and soil samples. The ratio helium-4/argon-36 was measured in soil gas.

37674 (GJBX—178(80)) **Aerial gamma ray and magnetic survey: Mississippi and Florida airborne survey, Memphis quadrangle, Arkansas, Missouri, and Tennessee. Final report.** (EG and G GeoMetrics, Sunnyvale, CA (USA)). Aug 1980. Contract AC13-76GJ01664. 304p. NTIS, PC E11/MF $4.50.

The Memphis quadrangle covers a region at the western edge of the Gulf Coastal Province. Thick Cenozoic sediments unconformably overlie Paleozoics in the east. The underlying Paleozoic section is exposed in the northwest. A search of available literature revealed no known uranium deposits. Seventy-two uranium anomalies were detected and are discussed briefly. None were considered significant, and most appear to relate to some cultural feature. Magnetic data appear, for the most part, to be in agreement with existing structural interpretations of the region.

37675 (GJBX—185(80)) **Hydrogeochemical and stream sediment reconnaissance basic data for Grand Island NTMS Quadrangle, Nebraska/Kansas.** (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 31 Jul 1980. Contract W-7405-ENG-26. 380p. (K/UR—140). NTIS, PC E09/MF $3.50.

Results of a reconnaissance geochemical survey of the Grand Island Quadrangle, Nebraska/Kansas are reported. Statistical data and areal distributions for uranium and uranium-related variables are presented for 564 groundwater and 532 stream sediment samples. Also included is a brief discussion on location and geologic setting. Groundwater data indicate that uranium concentrations above the 85th percentile occur primarily in shallow wells (0 to 20 m) along or near the Platte and Republican Rivers, which flow west to east along the northern and southern portions of the quadrangle, respectively. Waters containing high concentration of uranium in the northern portion of the quadrangle occur in recent alluvium and nearby glacial deposits. In the southern portion of the quadrangle, waters containing high uranium concentrations occur in Recent alluvium and the Niobrara Chalk in the southeast. Stream sediment data indicate that uranium concentrations above the 85th percentile occur in sediments along the Platte River in the northern portion of the quadrangle and paralleling the Republican River in the southeastern portion. Sediments with high uranium values along the Platte River are derived from glacial and alluvial deposits. High uranium values paralleling the Republican River in the southeast are derived from the Niobrara Chalk, the Carlile Shale, and glacial and alluvial deposits. High U-NT and thorium values, and high values for cerium, niobium, scandium, titanium, vanadium, yttrium, and zirconium suggest the presence of clays and/or residual minerals in the southeast. Sediment derivation and the leaching of possible ash-rich loess and alluvial deposits and/or uranium-rich alkaline evaporite deposits could account for high uranium concentrations in sediment and groundwaters within the quadrangle.

37676 (GJBX—198(80)) **Delta 1° x 2° NTMS area, Utah: data report (abbreviated).** Fay, W.M. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Aug 1980. Contract AC13-76GJ01664. 18p. (DPST—80-146-12). NTIS, PC E03/MF $3.50.

Results of ground water and stream/surface sediment reconnaissance in the National Topographic Map Series Delta 1° x 2° quadrangle are presented. Surface sediment samples were collected at 1311 sites, at a target sampling density of 1 site/13^2 kilometers. Ground water samples were collected at 140 sites. Neutron activation analysis results are given for U and 16 other elements in sediments, and for U and 9 other elements in ground water. Mass spectrometry results are given for He in ground water. Data from ground water sites include: water chemistry measurements; (pH, conductivity, and alkalinity); physical measurements where applicable (water temperature, well description, and scintillometer reading); and elemental analyses (U, Al, Br, Cl, Dy, F, He, Mg, Mn, Na, and V). Data from sediment sites include: stream water chemistry measurements from sites where water was available; and elemental analyses for sediment samples (U, Th, Hf, Al, Ce, Dy, Eu, Fe, La, Lu, Mn, Sc, Sm, Na, Ti, V, and Yb). Sample site descriptors are also tabulated. Areal distribution maps, histograms, and cumulative frequency plots for most elements; U/Th, U/Hf, U/(Th + Hf), and U/La rations; and scintillometer readings at sediment sample sites are included on the microfiche. U concentrations in sediments of the Delta quadrangle are relatively low. The highest U values, up to 37.9 ppM, are in samples which also have relatively high Th contents. This suggests that most of the U in these samples is held within monazite crystals. Most of these samples with the highest U/Th ratios are from flat-lying valley areas; therefore, the U may have precipitated from ground or surface waters. Several ground-water samples have anomalously high (up to 55.6 ppB) U concentrations. Two of the anomalous samples were collected in the northeast portion of the quadrangle which is underlain by Miocene granite rocks.

37677 (GJBX—200(80)) **Aerial gamma ray and magnetic survey: Mississippi and Florida airborne survey, Fort Smith quadrangle, Oklahoma, and Arkansas. Final report.** (EG and G GeoMetrics, Sunnyvale, CA (USA)). Sep 1980. Contract AC13-76GJ01664. 368p. NTIS, PC E09/MF $4.10.

The Fort Smith quadrangle in western Arkansas and eastern Oklahoma overlies thick Paleozoic sediments of the Arkoma Basin. These Paleozoics dominate surface exposure except where covered by Quaternary Alluvial materials. Examination of available literature shows no known uranium deposits (or occurrences) within the quadrangle. Seventy-five groups of uranium samples were defined as anomalies and are discussed briefly. None were considered significant, and most appeared to be of cultural origin. Magnetic data show character that suggest structural and/or lithologic complexity, but imply relatively deep-seated sources.

37678 (GJBX—202(80)) **Aerial gamma ray and magnetic survey: Mississippi and Florida airborne survey, Nashville quadrangle, Tennessee, and Kentucky. Final report.** (EG and G GeoMetrics, Sunnyvale, CA (USA)). Sep 1980. Contract AC13-76GJ01664. 352p. NTIS, PC E08/MF $4.10.

The Nashville quadrangle covers a portion of the interior lowland plateau region of the Midwestern Physiographic Province. The quadrangle contains a shallow to moderately thick Paleozoic section that overlies a Precambrian basement complex. Paleozoic carbonates dominate surficial exposures. A search of available literature revealed no known uranium deposits. Fifty-five uranium anomalies were detected and are discussed briefly. Most anomalies appear to relate to cultural features. Some have relatively high uranium concentration levels that may be significant despite their correlation with culture. Magnetic data appear to illustrate complexities in the Precambrian basement.

37679 (GJBX—203(80)) **Aerial gamma ray and magnetic survey: Mississippi and Florida airborne survey, Tupelo quadrangle, Mississippi, Alabama, and Tennessee. Final report.** (EG and G GeoMetrics, Sunnyvale, CA (USA)). Sep 1980. Contract AC13-76GJ01664. 382p. NTIS, PC E09/MF $4.10.

The Tupelo quadrangle covers a region immediately east of the Mississippi River flood plain in the northernmost Gulf Coastal Physiographic Province. Sediments of Teritary and Paleozoic basins shoal eastward. Tertiary exposures dominate the western half of the quadrangle. Cretaceous strata are exposed over most of the eastern half. A search of available literature revealed no known uranium deposits. A total of eighty-six uranium anomalies were detected and are discussed briefly. Few were considered significant, and most appear to relate to some cultural feature. Magnetic data appears, for the most part, to be in agreement with existing structural interpretations of the region.

37680 (GJBX—204(80)) **Aerial gamma ray and magnetic survey: Mississippi and Florida airborne survey, Russellville quadrangle, Arkansas.** (EG and G GeoMetrics, Sunnyvale, CA (USA)). Sep 1980. Contract AC13-76GJ01664. 354p. NTIS, PC E09/MF $3.95.

The Russellville quadrangle in north central Arkansas overlies thick Paleozoic sediments of the Arkoma Basin. These Paleozoics dominate surface exposure except where covered by Quaternary alluvial materials. Examination of available literature shows no known uranium deposits (or occurrences) within the quadrangle. Eighty-eight groups of uranium samples were defined as anomalies and are discussed briefly. None were considered significant, and most appeared to be of cultural origin. Magnetic data show character that suggest structural and/or lithologic complexity, but imply relatively deep-seated sources.

37681 (GJBX—212(80)) **Aerial gamma ray and magnetic survey, Montrose detail projects, Colorado. Volume I. Final report.** (EG and G GeoMetrics, Sunnyvale, CA (USA)). Apr 1980. Contract AC13-76GJ01664. 69p. NTIS, PC A04/MF A01.

In the months of August, September, and October 1978, EG and G geoMetrics collected 4231 miles of high sensitivity airborne radiometric and magnetic data in southwestern Colorado. Data were collected on traverse lines 1/4 mile apart and on tie lines of approximately 6 mile spacing in five separate detail areas primarily within the Montrose 1^0 x 2^0 sheet. All data were fully reduced and interpreted by geoMetrics and are presented as six volumes (one Volume I and five Volume II's) in this final report. A complex group of mid-Tertiary acidic to intermediate intrusive and extrusive rocks dominate the surface of most of the detail areas. In the westernmost area the igneous sequence overlies Colorado Plateau formations primarily of Cretaceous age. In the east, Precambrian and Paleozoic rocks are the dominant underlying rock types. Economic mineral deposits abound in this area, and several uranium mines (and prospects) are present. In addition to the standard data presentations and processing procedures, the data were examined for anomalous uranium values and mappable geochemical subunits using the radiometric and magnetic data. Principal component analysis was performed on the radiometric data using standard deviation subunits defined by Bendix Field Engineering Corporation.

37682 **Subthreshold neutron interrogator for detection of radioactive materials.** Evans, M.L.; Menlove, H.O.; Baker, M.P. (to Dept. of Energy). US Patent 4,201,912. 6 May 1980. Filed date 3 Oct 1978. 6p.

PAT-APPL-948,266.

A device is described for detecting fissionable material such as uranium in low concentrations by interrogating with photoneutrons at energy levels below 500 keV, and typically about 26 keV. Induced fast neutrons having energies above 500 keV by the interrogated fissionable material are detected by a liquid scintillator or recoil proportional counter which is sensitive to the induced fast neutrons. Since the induced fast neutrons are proportional to the concentration of fissionable material, detection of induced fast neutrons indicate concentration of the fissionable material.

37683 (GJBX—212(80)(Vol.2)(AREA1)) **Aerial gamma ray and magnetic survey, Montrose detail Area 1, Colorado. Final report.** (EG and G GeoMetrics, Sunnyvale, CA (USA)). May 1980. Contract AC13-76GJ01664. 634p. NTIS, PC E14/MF $4.70.

The Montrose Detail Area No. 1 covers a 150 square mile area near the central portion of the San Juan Volcanic Region. The areas' geology is completely dominated by Tertiary volcanic events and subsequent surficial modifications. A group of 25 groups of samples in the uranium window constitute anomalies as defined in Volume I. These anomalies lie over the highest uranium, thorium, and potassium count rate areas primarily in the La Garita Mountains and the South Fork Saquache Creek drainage. Highest count rates appear to be associated with certain tuffaceous units as mapped. High gradients completely dominate the magnetic signature of the area. Little correlation with the radiometric data was expected or observed. The region appeared geochemically homogenous on the basis of radiometric data according to the criteria set forth in Volume I.

37684 (GJBX—212(80)(Vol.2)(AREA5)) **Aerial gamma ray and magnetic survey, Montrose detail Area 5, Colorado. Final report.** (EG and G GeoMetrics, Sunnyvale, CA (USA)). Apr 1980. Contract AC13-76GJ01664. 318p. NTIS, PC E08/MF $3.95.

The Montrose Detail Area No. 5 consists of a 180 square mile area covering portions of the West Elk Mountains, the Ruby Range, and associated mountainous regions of the Southern Rocky Mountains. The area's geology is dominated by Tertiary intrusive and extrusive rocks related to the West Elk Mountains Volcanic Province. Some exposures of underlying Tertiary and Cretaceous material are present. The Irwin Mining District (Anthracite) lies within the detail area, as well as several small prospects for zinc, lead, and silver. No uranium occurrences are known to be associated with these mineralized areas. A total of 26 groups of samples in the uranium window constitute anomalies as defined in Volume I. These anomalies lie over the highest uranium count rate areas in the Ruby Range, the Anthracite Range, and the East Beckwith Mountain area. The highest count rates appear associated with dikes of granodiorite and/or white quartz porphyry. Magnetic data outline the major intrusive and extrusive bodies in the south, but only partially define the intrusive complex to the north. Little correlation with the radiometric data was expected or observed. Despite a wide range in the count rates of the three radioisotopes, the area appeared to be geochemically homogeneous according to the criteria set forth in Volume I. Other methods of separating geochemically distinctive areas may be more successful. Multivariate analysis showed a high degree of correleation between the three isotopes.

37685 **Geophysical technology for uranium exploration and evaluation.** Dodd, P.H. (DOE, Grand Junction, Colo). pp 107-135 of Uranium resource/technology seminar 2, 1979. Golden, CO; Colorado School of Mines (1979).

From Uranium resource technology seminar; Golden, CO, USA (12 Mar 1979).

Recent developments emphasize sensitive gamma-ray spectrometry, direct uranium logging by fission neutron techniques, neutron-neutron logs, emanometry surveys for radon and helium, and indirect geophysical-geochemical measurements of geology and alteration by use of magnetic intensity and susceptibility, electrical, seismic and isotopic measurements. 18 refs.

MINING

REFER ALSO TO CITATION(S) 37669, 37689

37686 (PNL—3439) **Some implications of in situ uranium mining technology development.** Cowan, C.E.; Parkhurst, M.A.; Cole, R.J.; Keller, D.; Mellinger, P.J.; Wallace, R.W. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Sep 1980. Contract AC06-76RL01830. 157p. NTIS, PC A08/MF A01.

A technology assessment was initiated in March 1979 of the in-situ uranium mining technology. This report explores the impediments to development and deployment of this technology and evaluates the environmental impacts of a generic in-situ facility. The report is divided into the following sections: introduction, technology description, physical environment, institutional and socioeconomic environment, impact assessment, impediments, and conclusions. (DLC)

37687 (PNL—3439(Exec.Summ.)) **Some implications of in situ uranium mining technology development.** Cowan, C.E.; Parkhurst, M.A.; Cole, R.J.; Keller, D.; Mellinger, P.J.; Wallace, R.W. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Sep 1980. Contract AC06-76RL01830. 21p. NTIS, PC A02/MF A01.

The assessment indicates that there do not appear to be any significant demonstrated negative environmental impacts. Moreover, the impacts of in situ mining compare favorably with those impacts expected from conventional mining techniques. Exposure to radioactive elements is less, atmospheric emissions of radioactive and nonradioactive materials are generally less and socioeconomic impacts are decreased. In fact, because of the generally small and unskilled labor forces associated with in-situ mining, development has provided much needed economic stimulus to economically depressed areas of Texas. There are still, however, several areas of unknowns and several areas of inadequate information that will need to be addressed before a complete quantification evaluation of impacts can be made. These areas include levels of radon emissions and groundwater restoration methods and impacts. Several issues mostly relating to the interaction of industry with state and Federal regulators need to be addressed.

FEED PROCESSING

REFER ALSO TO CITATION(S) 38497

37688 (MIT-EL—80-001) **Prospects for the recovery of uranium from seawater. Final report.** Best, F.R.; Driscoll, M.J. (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.; Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). Jan 1980. Contract AM01-76EI02295. 260p. (MITNE—231). NTIS, PC A12/MF A01.

A computer program entitled URPE (Uranium Recovery Performance and Economics) has been developed for analysis of a plant recovering uranium from seawater. The conceptual system design consists of a floating oil-rig type platform, using seawater forced through hydrous titanium oxide. Uranium is recovered from the seawater by adsorption and eluted later. The equilibrium isotherm and the diffusion constant for the uranyl-HTO system, which are needed for bed performance calculations, have been calculated. The URPE program has been benchmarked against previous studies by ORNL and Exxon, and found to make comparable performance and economic estimates. The URPE code was then used to identify optimum bed operating conditions. Thin beds of small, thinly-coated particles are the preferred bed configuration, and actively pumped systems outperform current driven units. Based on URPE, the minimum expected costs of uranium recovered from seawater would be no lower than ~ 316 (1979$)/lb U_3O_8 for state-of-the-art adsorber material (capacity equal to 210 mg U/kg Ti), but might be reduced to the level of breakeven attractiveness of ~ 150 (1979$)/lb U_3O_8 if at least a four-fold increase in adsorption capacity could be achieved.

37689 (PB—80-805443) **Uranium mining and milling environmental studies (citations from the NTIS data base). Report for 1964-Feb 1980.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Feb 1980. 248p. NTIS PC N01/MF N01.

Pollution, public and occupational health, and waste management associated with uranium ore recovery and processing are cited. The monitoring and control of contamination in air and effluents in the mining vicinities are discussed in this collection of Federally-funded research. (This updated bibliography contains 242 abstracts, 39 of which are new entries to the previous edition.)

37690 (PB—80-805450) **Uranium mining and milling environmental studies (citations from the Engineering Index data base). Report for 1970-Feb 1980.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Feb 1980. 107p. NTIS PC N01/MF N01.

Worldwide research is cited on uranium mining waste management and effluent control. Studies on mining practices, radon monitoring, health hazards, and land reclamation are covered. Government policies and regulations concerning present and long term waste handling are included. (This updated bibliography contains 110 abstracts, 24 of which are new entries to the previous edition.)

37691 **Processing marginal uranium reserves.** Woolery, R.G. (Union Carbide Corp, Niagara Falls, NY). pp 190-200 of Uranium resource/technology seminar 2, 1979. Golden, CO; Colorado School of Mines (1979).

From Uranium resource technology seminar; Golden, CO, USA (12 Mar 1979).

This paper attempts to classify the options currently in use and to compare their relative merits. The heap leach process is best adapted to low-grade reserves, the vat leach process to inteprmediate-grade reserves, and the slurry-leach transportable plant to the high-grade reserves.

FUELS PRODUCTION AND PROPERTIES

REFER ALSO TO CITATION(S) 37747, 37766

37692 **Neutron source, linear-accelerator fuel enricher and regenerator and associated methods.** Steinberg, M.; Powell, J.R.; Takahashi, H.; Grand, P.; Kouts, H. (to Dept. of Energy). US Patent Application 081,988. 4 Oct 1979. 33p.

A device for producing fissile material inside of fabricated nuclear elements so that they can be used to produce power in nuclear power reactors is described. Fuel elements, for example, of a LWR are placed in pressure tubes in a vessel surrounding a liquid lead-bismuth flowing columnar target. A linear-accelerator proton beam enters the side of the vessel and impinges on the dispersed liquid lead-bismuth columns and produces neutrons which radiate through the surrounding pressure tube assembly or blanket containing the nuclear fuel elements. These neutrons are absorbed by the natural fertile uranium-238 elements and are transformed to fissile plutonium-239. The fertile fuel is thus enriched in fissile material to a concentration whereby they can be used in power reactors. After use in the power reactors, dispensed depleted fuel elements can be reinserted into the pressure tubes surrounding the target and the nuclear fuel regenerated for further burning in the power reactor.

37693 **Nondestructive assay system for use in decommissioning a plutonium-handling facility.** Roche, C.T.; Vronich, J.J.; Bellinger, F.O.; Perry, R.B. (Argonne Natl Lab, Ill). *Nucl. Mater. Manage.;* **8**: 162-173(1979).

Argonne National Laboratory is decommissioning a facility used to fabricate reactor fuel elements. The equipment is contaminated with alpha emitters at levels up to 10^{12} dpm/100 cm^2. The objective of decontamination is to reduce the TRU concentrations below 10 nCi/g of waste. A portable NDA procedure using NaI(Tl) gamma-spectrometric techniques was selected to measure the residual Pu and ^{241}Am in the glove boxes. 13 refs.

SPENT FUELS REPROCESSING

REFER ALSO TO CITATION(S) 37712, 37713, 37724, 37748, 37753, 37761, 37765

37694 (CONF-800802—19(Draft)) **Calculated and experimental studies of nonequilibrium solvent extraction of uranium-thorium and uranium-zirconium.** Mailen, J.C.; Horner, D.E. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 15p. NTIS, PC A02/MF A01.

From 89. annual meeting of the American Institute of Chemical Engineers; Portland, OR, USA (17 Aug 1980).

The nonequilibrium simultaneous transfer of ions in solvent extraction has been examined experimentally and these results have been compared with the calculated behavior determined using transfer rate constants. In the Th-U system when transferring from 2 M HNO_3 into 30% tributyl phosphate (TBP) in normal hydrocarbon diluent (NPH), the thorium approaches equilibrium faster than uranium over much of the transfer region. Thus, nonequilibrium operation will not increase the separation factor between uranium and thorium over that attained at equilibrium. However, in the Zr-U system when transferring from 3.4 M HNO_3 into 30% TBP-NPH, the separation factor between uranium and zirconium is increased over that attained at equilibrium over much of the transfer region due to the relatively slow transfer of $ZrOH^{3+}$, one of the two extractable forms of zirconium. Thus, the uranium-zirconium separation factor can potentially be increased by the use of short, nonequilibrium residence times.

37695 (CONF-800943—14) **Remotex: a new concept for efficient remote operation and maintenance in nuclear fuel reprocessing.** Feldman, M.J.; White, J.R. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 24p. NTIS, PC A02/MF A01.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

Remotex is a concept of remote operation and maintenance that utilizes advanced manipulator design to improve plant operating efficiency, reduce personnel exposure, and improve safeguards and diversion resistance. It is a concept developed over the past two years in the conceptual design of the Hot Experimental Facility (HEF), a mechanically intense pilot plant facility designed to demonstrate reprocessng technology for early US breeder demonstration reactors. The Remotex concept is directly applicable to all segments of nuclear and nonnuclear industries where work tasks or conditions exist that are hazardous to the health of man.

37696 (CONF-800943—15) **Facility and equipment concepts for the Hot Experimental Facility.** White, J.R.; North, E.D.; Bottenfield, B.F. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 26p. NTIS, PC A03/MF A01.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

Portions of document are illegible.

Work on the conceptual design of a pilot-scale plant for reprocessing breeder reactor fuels is being performed at the Oak Ridge National Laboratory. The plant design will meet current federal requirements for licensability and for the safeguards of special nuclear materials, and will serve as a prototype for future production plants. A unique feature of the concept is the incorporation of totally remote operation and maintenance of the process equipment within a large barn-like hot cell. This approach, called Remotex, provides significant improvements for fuel reprocessing plants and other nuclear facilities in the areas of safeguarding nuclear materials, reducing radiation exposure, improving plant availability, recovering from unplanned events, and plant decommissioning.

37697 (DP-MS—80-10) **Voloxidation and dissolution of irradiated plutonium recycle fuels.** Cadieux, J.R.; Stone, J.A. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1980. Contract AC09-76SR00001. 13p. (CONF-800943—12). NTIS, PC A02/MF A01.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

Voloxidation removed > 99.4% of the tritium in the fuels tested (LWR recycled fuels containing ^{239}Pu). Voloxidation increased the amount of insoluble residue by roughly a factor of two. Voloxidation increased the amount of plutonium in the insoluble

residue by factors of 4 to 5. Voloxidation made the insoluble plutonium much harder to dissolve.

37698 (DP-MS—80-12) **Alpha-contained laboratory scale pulse column facility for SRL.** Reif, D.J.; Cadieux, J.R.; Fauth, D.J.; Thompson, M.C. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1980. Contract AC09-76SR00001. 29p. (CONF-800943—13). NTIS, PC A03/MF A01.

From National topical meeting of fuel cycles for the 80's; Gatlinburg, TN, USA (29 Sep 1980).

For studying solvent extraction processes, a laboratory-sized pulse column facility was constructed at the Savannah River Laboratory. This facility, in conjunction with existing miniature mixer-settler equipment and the centrifugal contactor facility currently under construction at SRL, provides capability for cross comparison of solvent extraction technology. This presentation describes the design and applications of the Pulse Column Facility at SRL.

37699 (DP-MS—80-59) **Application of probabilistic risk assessment to nuclear fuel reprocessing at the Savannah River Plant.** Durant, W.S. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1980. Contract AC09-76SR00001. 14p. (CONF-801104—2). NTIS, PC A02/MF A01.

From 73. annual meeting of the American Institute of Chemical Engineers; Chicago, IL, USA (12 Nov 1980).

The Savannah River Laboratory has developed an integrated risk assessment methodology that has been applied to systems in the nuclear fuel reprocessing facilities at the Savannah River Plant. The methodology can be applied to several types of design and operational problems. Basically, the analysis is subdivided into individual modules that can be either utilized separately or integrated into an overall risk analysis. Computer codes and computer data banks are utilized extensively to minimize the manual effort. The flow of information begins with a definition of the system to be analyzed followed by an evaluation of sources of fault information, storage of this information in data banks, design analysis and data treatment, risk calculations, and end product options.

37700 (DPSPU—80-30-6) **Purex optimization by computer simulation.** Campbell, T.G.; McKibben, J.M. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). Aug 1980. Contract AC09-76SR00001. 15p. (CONF-800814—17). NTIS, PC A02/MF A01.

From 180. American Chemical Society meeting/2. chemical congress of the North American Continent; San Francisco, CA, USA (24 Aug 1980).

For the past 2 years computer simulation has been used to study the performance of several solvent extraction banks in the Purex facility at the Savannah River Plant in Aiken, South Carolina. Individual process parameters were varied about their normal base case values to determine their individual effects on concentration profiles and end-stream compositions. The data are presented in graphical form to show the extent to which product losses, decontamination factors, solvent extraction bank inventories of fissile materials, and other key properties are affected by process changes. Presented in this way, the data are useful for adapting flowsheet conditions to a particular feed material or product specification, and for evaluating nuclear safety as related to bank inventories.

37701 (ENICO—1034) **Technical quarterly progress report, October 1-December 31, 1979.** Plung, D.L. (ed.). (Exxon Nuclear Idaho Co., Inc., Idaho Falls (USA)). Jul 1980. Contract AC07-79ID01675. 116p. NTIS, PC A06/MF A01.

Special Materials Production: results of work on the long-term management of ICPP high-level wastes, ICPP plant process improvement, advanced graphite fuels reprocessing, ICPP waste management development, technical support to the New Waste Calcining Facility, effluent monitoring methods evaluation and development, and technical program improvement are reported. Results of work on pelleted waste form development, a Rover mass balance model, pneumatic transport studies, calciner autoignition studies, and development of a continuous alpha monitor are presented. Fuel Cycle Research and Development: results of krypton-85 storage development work are presented. This quarter's work focused on: (1) krypton zeolite encapsulation - including krypton loading and leakage tests and zeolite materials development, and (2) krypton storage development - including conceptual design alternatives, materials and pilot-plant testing, and long-term tests. Other Energy Projects: results of work are presented on nuclear materials security, reactor source term program, burnup methods for fast breeder reactor fuels, specialized fuel research - analytical support, negative thermal ionization mass spectrometry, iodine adsorber evaluation program, and Oklo studies. In addition, results of work on radiological consequences of containment purge, iodine pathway studies, and offsite emergency instrumentation for accidents involving light-water nuclear power plants are reported.

37702 (PNL—3446) **Prototype arc saw design and cutting trials.** Allison, G.S. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Sep 1980. Contract AC06-76RL01830. 34p. NTIS, PC A03/MF A01.

A program was initiated to develop the arc saw as a tool capable of removing the end fittings from spent nuclear fuel bundles. A special arc saw for this purpose was designed, installed at the Pacific Northwest Laboratory and satisfactorily operated to remove end fittings from simulated, nonradioactive fuel bundles. The design of the arc saw included consideration of the cutting environment, power supply size, control equipment, and work piece size. Several simulated fuel bundles were cut to demonstrate that the arc saw met design specifications. Although the arc saw development program was curtailed before significant performance data could be collected, tests indicate that the arc saw is a good means of cropping spent fuel bundles and is well suited to remote operation and maintenance.

37703 (PNL-TR—409) **Investigations of the solidification of feed clarification sludge in an inorganic matrix resistant to radiation and heat (vitrification), Subproject B.** Stammler, M.; Eggersdorfer, R.; Gaar, H.; Harr, K.; Schwaemmlein, W.; Sherriff, R. (Battelle-Institut e.V., Frankfurt am Main (Germany, F.R.)). 13 Oct 1980. Translation of BMFT-FB (KWA 1688 A), April 1980. 105p. NTIS, PC A06/MF A01.

After concentration, dissolver sludge can be embedded into a glass matrix. The resulting product shows high radiation and recrystallization stability. The process to make the product is simple and causes practically no secondary waste. Mixtures of simulated FKS and frit can be processed into spherical pellets on a pelletizing disc. Another possibility is to pour the mixture into hemispherical cavities in a suitable substrate material. Sintering at about 700°C results in pellets with a vitrified surface. Some of the equipment necessary for the process has been tested.

37704 **Nondestructive examination of irradiated LWR fuel assemblies.** Phillips, J.R.; Lee, D.M.; Bement, T.R.; Halbig, J.K.; Hsue, S.T.; Kaieda, K. (Univ of Calif, Los Alamos Sci Lab, NM). *Nucl. Mater. Manage.;* **8**: 451-467(1979).

Nondestructive gamma-ray and neutron techniques have been investigated to determine their applicability to the characterization of irradiated LWR fuel assemblies for safeguards. MTR, BWR, and PWR assemblies have been examined. Relative cooling times and burnup values are correlated with operator-declared values. Various gamma-ray techniques have been developed to measure rapidly the axial burnup profile for calculating the integral burnup of individual fuel assemblies. 7 refs.

TRANSPORT AND STORAGE

REFER ALSO TO CITATION(S) 38175, 38534

37705 (HEDL-TME—79-20) **Spent fuel data for waste storage programs.** Greene, E.M. (Hanford Engineering Development Lab., Richland, WA (USA)). Sep 1980. Contract AC14-76FF02170. 102p. NTIS, PC A06/MF A01.

Data on LWR spent fuel were compiled for dissemination to participants in DOE-sponsored waste storage programs. Included are mechanical descriptions of the existing major types of LWR fuel assemblies, spent LWR fuel fission product inventories and decay heat data, and inventories of LWR spent fuel currently in storage, with projections of future quantities.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 37669

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 37701, 38548

37706 (DP—80-125-1) **Waste management program technical progress report, January-March 1980.** (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Sep 1980. Contract AC09-76SR00001. 77p. NTIS, PC A05/MF A01.

This quarterly report provides current information on operations and development programs for the management of radioactive wastes from operation of the Savannah River Plant. Process and equipment development studies are reported in the Long-Term Management Technology Program. The following studies are reported for Interim Waste Operations: surveillance and maintenance, waste concentration, low-level effluent waste, waste tank evaluation, and tank replacement/waste transfer (formerly waste tank retirement). The development of criteria for the selection of sites for storage of waste forms produced in the Defense Waste Processing Facility is described in the commercial waste program.

37707 **Recovery process.** Horwitz, E.P.; Delphin, W.H.; Mason, G.W. (to Department of Energy, Washington, DC (USA)). German(FRG) Patent 2,856,489/A/. 5 Jul 1979. 26p. (In German).

37708 (NVO—196-18) **Nevada Nuclear Waste Storage Investigations. Management and overview Quality Assurance Program Plan.** (Department of Energy, Las Vegas, NV (USA). Nevada Operations Office). Aug 1980. 33p. NTIS, PC A03/MF A01.

The Nevada Nuclear Waste Storage Investigations (NNWSI) Project Office is the US Department of Energy, Nevada Operations Office (DOE/NV) organization charged with the responsibility of administering and coordinating the activities of the various Participating Organizations and Support Contractors working on the NNWSI project. This Quality Assurance Program Plan (QAPP) describes how the NNWSI Project Office and their consultant and advisory organizations, Technical Overview and Quality Assurance Overview, perform the quality assurance (QA) aspects of administering and coordinating NNWSI activities. This QAPP was developed to comply with the elements of 10CFR50 Appendix B (Ref. A) criteria which apply to the activities of the Project Office and their advisory staff. These activities are intended to conform with the applicable portions of ANSI/ASME NQA-1-1979 (Ref. B).

37709 (ORNL—5665, pp 111-127) **Nuclear waste chemistry.** Jul 1980.

In Chemistry Division annual progress report, February 29, 1980.

The consolidation of salt in flowing brine was studied under uniaxial stress and the results correlated using a model. Adsorption of such ions as Cs(I), Sr(II), Eu(III), and I^- on such earth materials as clays or Al_2O_3 is being studied. Molten-salt processes are being investigated for separating components of high-level wastes; separation of Pd from Ru and complexes formed by $NbCl_5$ in chloroaluminate melts were studied. Adsorption of actinides (Am,Np) on geological media is being studied. Lanthanide orthophosphates are being synthesized and studied (EPR, Raman,absorption, Moessbauer spctra) as possible alternatives to glass as actinide waste forms. 18 figures. (DLC)

37710 (PNL-SA—7072/T1) **Management of high-level nuclear wastes.** Platt, A.M.; McElroy, J.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Dec 1978. Contract AC06-76RL01830. 33p. NTIS, PC A03/MF A01.

Significant developments in the management of high-level nuclear wastes that have occurred in the last 2 years are reviewed. The principal thrust is on the policy and technical developments in the United States, but some attention is paid to major developments in other countries which have impacted technical direction in the US.

WASTE PROCESSING

REFER ALSO TO CITATION(S) 37693, 37733

37711 (BNL—28193) **Keynote address at the international conference on nuclear waste transmutation.** Steinberg, M. (Brookhaven National Lab., Upton, NY (USA)). Jul 1980. Contract AC02-76CH00016. 13p. (CONF-800743—13). NTIS, PC A02/MF A01.

From International conference on nuclear waste transmutation; Austin, TX, USA (22 Jul 1980).

Most of the US research effort on radioactive waste management is concentrated on its solidification and storage in geologic formations. Transmutation is an alternative. It can be applied to weapons plutonium as well to spent fuel. (DLC)

37712 (CONF-800743—12) **Removal of actinides from nuclear fuel reprocessing wastes: engineering studies.** Maxey, H.R.; McIsaac, L.D.; Chamberlain, D.B.; McManus, G.J. (Exxon Nuclear Idaho Co., Inc., Idaho Falls (USA)). 1980. Contract AC07-ID01675. 25p. NTIS, PC A02/MF A01.

From International conference on nuclear waste transmutation; Austin, TX, USA (22 Jul 1980).

The major pilot plant effort has been directed towards understanding the behavior of the extraction column. This emphasis was placed on extraction because the actinide-free raffinate from this column is the process product. Although actual radioactive feeds have been used only in a very limited number of tests, the combination of simulated column tests, minimixer-settler tests, and pilot plant experiments have shown that an actinide-free raffinate can be produced. A pulsed sieve plate column can achieve this separation in a reasonable height. In the design of an extraction process, there are several tradeoffs that have to be examined. One such tradeoff is that between column capacity and separation efficiency; an increase in column diameter (or capacity) means a faster processing rate, but, unfortunately, it also means a decrease in column efficiency. Therefore, the greater the diameter, the larger the HTU and the higher the column has to be to achieve the desired separation. In nuclear applications this is very important since column height is limited by the size of the process containment building. In increasing the diameter from 3 to 8 inches, an increase in HTU's up to 50% was observed by Sege. For plant operations, the pulse columns could probably be pulsed at 40 CPM, 2.5 cm per pulse. At these conditions, the HTU should be no greater than 0.75 m, even considering changes resulting from scaleup.

37713 (CONF-801038—1(Draft)) **Organic iodine removal from simulated dissolver off-gas streams using silver-exchanged mordenite.** Jubin, R.T. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 31p. NTIS, PC A03/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

The removal of methyl iodide by absorption onto silver mordenite was studied using a simulated off-gas from the fuel dissolution step of a nuclear fuel reprocessing plant. The methyl iodide absorption of silver mordenite was examined for the effects of NO/sub x/, humidity, iodine concentration, filter temperature, and filter pretreatment. The highest iodine loading achieved in these tests has been 34 mg CH_3I per g of substrate, approximately five times less than the elemental iodine loadings. Results indicate that a filter operating at a temperature of 150°C obtained higher iodine loadings than a similar filter operating at 100°C. Pretreatment of the sorbent bed with hydrogen, rather than dry air, at a temperature of 200°C also improved the loading. Variations in the methyl iodide concentration had minimal effects on the overall loading. Filters exposed to moist air streams attained higher loadings than those in contact with dry air. A study of the regeneration characteristics of silver mordenite indicates limited adsorbent capacity after complete removal of the iodine with 4% hydrogen in the regeneration gas stream at 500°C. 9 figures.

37714 (CONF-801038—4) **Volatilities of ruthenium, iodine, and technetium on calcining fission product nitrate wastes.** Rimshaw, S.J.; Case, F.N. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 28p. NTIS, PC A03/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

Various high-level nitrate wastes were subjected to formic acid denitration. Formic acid reacts with the nitrate anion to yield noncondensable, inert gases according to the following equation: $4\ HCOOH + 2\ HNO_3 \rightarrow N_2O + 4\ CO_2 + 5\ H_2O$. These gases can be scrubbed free of ^{106}Ru, ^{131}I, and ^{99}Tc radioactivities prior to elimination from the plant by passage through HEPA filters. The formation of deleterious NO/sub x/ is avoided. Moreover, formic acid reduces ruthenium to a lower valence state with a sharp reduction in RuO_4 volatility during subsequent calcination of the pretreated waste. It is shown that a minimum of 3% of RuO_4 in an off-gas stream reacts with Davison silica gel (Grade 40) to give a fine RuO_2 aerosol having a particle size of 0.5 μ. This RuO_2 aerosol passes through water or weak acid scrub solutions but is trapped by a caustic scrub solution. Iodine volatilizes almost completely on calcining an acidic waste, and the iodine volatility increases with increasing calcination temperature. On calcining an alkaline sodium nitrate waste the iodine volatility is about an order of magnitude lower, with a relatively low iodine volatility of 0.39% at a calcination temperature of 250°C and a moderate volatility of 9.5% at 600°C. Volatilities of ^{99}Tc were generally <1% on calcining acidic or basic wastes at temperatures of 250 to 600°C. Data are presented to indicate that ^{99}Tc concentrates in the alkaline sodium nitrate supernatant waste, with ~ 10 mg ^{99}Tc being associated with each curie of ^{137}Cs present in the waste. It is shown that lutidine (2,4 dimethyl-pyridine) extracts Tc(VII) quantitatively from alkaline supernatant wastes. The distribution coefficient (K/sub D/) for Tc(VII) going into the organic phase in the above system is 102 for a simulated West Valley waste and 191 for a simulated Savannah River Plant (SRP) waste.

37715 (DOE/AL/TRU—8003) **Economic comparison of centralizing or decentralizing processing facilities for defense transuranic waste.** Brown, C.M. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). Jul 1980. Contract AC04-76DP03533. 85p. NTIS, PC A05/MF A01.

This study is part of a set of analyses under direction of the Transuranic Waste Management Program designed to provide comprehensive, systematic methodology and support necessary to better understand options for national long-term management of transuranic (TRU) waste. The report summarizes activities to evaluate the economics of possible alternatives in locating facilities to process DOE-managed transuranic waste. The options considered are: (1) Facilities located at all major DOE TRU waste generating sites. (2) Two or three regional facilities. (3) Central processing facility at only one DOE site. The study concludes that processing at only one facility is the lowest cost option, followed, in order of cost, by regional then individual site processing.

37716 (DP-MS—80-50) **Effects of processing variables on the product quality of large-scale glass forms containing simulated SRP waste.** Plodinec, M.J. (Du Pont de Nemours (E.I.) and Co., Aiken,

SC (USA). Savannah River Lab.). 1980. Contract AC09-76SR00001. 15p. (CONF-801034—2). NTIS, PC A02/MF A01.

From 33. ACS Pacific Coast meeting; San Francisco, CA, USA (28 Oct 1980).

The reference process for disposal of radioactive waste from the Savannah River Plant is immobilization in borosilicate glass. Full-scale canisters containing simulated waste have been made by two processes: in-can melting and continuous joule-heated melting. For each process, melter atmosphere and the degree of feed mixing have been varied. The effects of these variations on glass quality parameters such as leach rate, degree of fracture and porosity, and amount of crystalline material are discussed.

37717 (EGG-FM—5241) **Iron-rich basalt-type waste forms for transuranic and low-level waste containment: evaluation of electromelt castings.** Flinn, J.E.; Kelsey, P.V. Jr.; Tallman, R.L.; Henslee, S.P.; Seymour, W.C. (Idaho National Engineering Lab., Idaho Falls (USA)). Apr 1980. Contract AC07-76ID01570. 136p. NTIS, PC A07/MF A01.

Seven castings, 90 kg each, were produced by an electromelt process. The melts were solidified in thin-walled mild or galvanized steel containers. The containers showed no evidence of interaction with the slag. Four of the castings, designated as A-series (average INEL transuranic (TRU)/low-level-waste composition plus soil additions), were subjected to more detailed examinations, including sectioning into half pairs and subsequent evaluation. Examinations showed that bulk defects in castings were crust formation, center cavity porosity, and minor cracking. Specimens removed from the castings at selected locations showed that density and chemical composition were relatively uniform within each casting. Casting microstructure showed a 75 to 90% devitrification. Crystalline-phase types were pyroxene (diopside and hedenbergite) and spinel. The amount of spinel in A-series castings was dependent on both the iron content and Fe^{2+}/Fe^{3+} ratio. Leach data on slag specimens showed comparable leach rates, based on weight-loss measurements and elemental analyses of spent leachants. Splitting tensile strengths and fracture toughness values from slag specimens used in this study are less than those measured for borosilicate glass.

37718 (ENICO—1051) **Development of a pelleted waste form for high-level alumina wastes.** Kirkbride, R.A. (Exxon Nuclear Idaho Co., Inc., Idaho Falls (USA)). Sep 1980. Contract AC07-79ID01675. 44p. NTIS, PC A03/MF A01.

A formulation to pelletize simulated high-level ICPP alumina waste calcine was developed. The pellets are formed on a 41-cm-diameter disc pelletizer using 5% bentonite, 2% metakaolin, and 5 wt % calcium hydroxide as a solid binder and a solution of 7M phosphoric acid and 4M nitric acid as a liquid binder. After drying and heat treatment at 800°C for 2 hours, the average crush strength of the pellets is 3.9 MPa and the pellets have a leach resistance of 10^{-3} g/cm²/day, based on Soxhlet leaching for 48 h at 95°C with distilled water.

37719 (MLM—2692) **Plutonium adsorption by selected inorganic compounds.** Silver, G.L. (Mound Facility, Miamisburg, OH (USA)). 10 Oct 1980. Contract AC04-76DP00053. 44p. NTIS, PC A03/MF A01.

Plutonium may be removed from aqueous solution by adsorption on inorganic materials. Hydroxylapatite, dibasic and tribasic calcium phosphate, calcium cyanamide, and sodium titanate are particularly noteworthy for their ability to concentrate plutonium. The extent of adsorption and pH of maximum adsorption depend upon the chemical form of the dissolved plutonium.

37720 (MLM—2774) **Combined Electrolysis Catalytic Exchange (CECE).** Ellis, R.E.; Mills, T.K.; Rogers, M.L. (Mound Facility, Miamisburg, OH (USA)). 30 Sep 1980. Contract AC04-76DP00053. 19p. NTIS, PC A02/MF A01.

Starting from an effort to control airborne emissions, the Mound tritium containment program has evolved to include development of the Combined Electrolysis Catalytic Exchange (CECE) process. This process separates tritiated aqueous streams into detritiated water and an enriched hydrogen stream that is suitable for use by other tritium recovery processes. Experimentation has shown that the process performs as predicted by bench-scale measurements, and that available process components exhibit acceptable resistance to damage by radiation from tritium exposure. Planned future efforts are concentrated on finalizing automatic control of the process and on developing feed treatment methods for the protection of process components.

37721 (MLM—2775(OP)) **Incineration of LWR-type waste at Mound Facility.** Alexander, B.M.; Grimm, R.S.; Doty, J.W. Jr. (Mound Facility, Miamisburg, OH (USA)). 1980. Contract AC04-76DP00053. 9p. (CONF-801038—2). NTIS, PC A02/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

The Mound Cyclone Incinerator, demonstrated over several years for the combustion of radwaste containing plutonium, is now being developed for volume reduction of radwaste containing mixed beta- and gamma-emitters, from LWR facilities. To this end, a laboratory-scale feasibility study was developed and executed. Development of the feasibility study was based on known characteristics of LWR waste and on operating data compiled for the Mound Cyclone Incinerator since 1975. Feed spiked with several isotopes found in LWR waste was burned in the laboratory-scale cyclone incinerator, and samples were collected and analyzed. From these data, the applicability of cyclone incineration was demonstrated, and an efficient scrub liquor composition was chosen for the offgas treatment system. A Health Physics survey of the incinerator system after incineration of 220 μCi of beta/gamma activity showed no exposure readings above background level. Future work planned includes incineration of simulated LWR waste in the full-scale Mound Cyclone Incinerator to begin later this year.

37722 (PB—80-122740) **Absorption of radium and thorium from Wyoming and Utah uranium mill tailings solutions. Report of investigations.** Beard, H.R.; Nichols, I.L.; Seidel, D.C. (Bureau of Mines, Salt Lake City, UT (USA). Salt Lake City Metallurgy Research Center). 1979. 21p. NTIS, PC A02/MF A01.

The Federal Bureau of Mines investigated the absorption of radium and thorium from waste uranium leach liquor by clays and other materials. This work was conducted in support of the Bureau's goal of minimizing the environmental conflicts, impacts, and occupational hazards associated with mining and mineral processing operations. Tailings and soil samples from Wyoming and Utah were contacted with tailings liquors to determine the degree of absorption. Absorption ranged from 0 to 99 percent for radium and from 0 to 31 percent for thorium. Some samples, which readily absorbed radium, were contacted with various salt solutions that could be present in tailings solutions to determine their effectiveness as desorbents. The desorption of radium ranged from 0.06 to 100 percent. An alpha-spectrometric method was used to determine the radium and thorium concentrations in the solutions and the solids.

37723 (RHO-ST—33) **System for retrieval of solidified Hanford high-level defense wastes: a design description.** Strickler, J.K.; Wallskog, H.A.; Wetch, J.R. (Rockwell International Corp., Richland, WA (USA). Energy Systems Group). Jul 1980. Contract AC06-77RL01030. 166p. NTIS, PC A08/MF A01.

The major objective of the Hanford defense waste retrieval activity is to design, develop, demonstrate, and qualify the equipment, staff, and methods required for the safe retrieval of solidified high-level radioactive wastes from the 133 large (75-foot-diameter) single-shell, underground storage tanks at Hanford. The program is currently limited to research, development, and demonstration of systems and technology in support of selecting an alternative for disposal of Hanford high-level defense waste. This report relates the requirements and sets forth much of the data and criteria currently known. It describes the preliminary design of a remotely operated, self-contained, mobile system which incorporates a mechanical, articulated mining boom. This boom, when equipped with a variety of suitable tools, can remotely cut up in-tank equipment, remove the debris, recover the solid wastes, clean the tank walls, and deposit the waste into a bucket elevator. The bucket elevator automatically removes the waste from the tank and deposits it into shielded shipping containers. The containers are remotely sealed, washed, and deposited into sealing containers. The containers are remotely sealed, washed, and deposited into sealing containers which are sealed and placed on a transfer vehicle for transport. All of the retrieval equipment is installed on a mobile platform which bridges the tank domes to avoid loading the dome structure. Mobility provides for progressing from tank to tank until all of the 75-foot-diameter, single-shell tanks have been emptied. Ancillary equipment includes in-tank viewing and lighting systems, positive filtered ventilation equipment for contamination control, equipment for washing tools and mining equipment, and includes provisions for remote maintenance of contaminated equipment, and quick removal and replacement of parts.

37724 (UCRL—84405) **Potential of pyroprocessing for partitioning purex wastes.** Coops, M.S.; Sisson, D.H. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 23 Jul 1980. Contract W-7405-ENG-48. 16p. (CONF-800743—10). NTIS, PC A02/MF A01.

From International conference on nuclear waste transmutation; Austin, TX, USA (22 Jul 1980).

The processes are extremely compact. The process reagents are highly resistant to radiation damage and, therefore, can be used to handle short-cooled, highly concentrated waste with negligible degradation. Most reagents can be recycled back through the process many times, thereby minimizing the generation of waste products, and also reducing the process cost. Fission-product wastes are discharged from the process as concentrated, solid wastes, typically in a metal matrix suitable for permanert disposal. Long cooling periods are not needed prior to conversion to a suitable waste form. The recovered actinides are obtained as metals and cen be easily

stored or shipped. Pyrochemical processing of nuclear fuels should be considered as a second generation technology.

WASTE DISPOSAL AND STORAGE

REFER ALSO TO CITATION(S) 37650, 37705, 37745, 37746, 37753, 38887, 38891, 38892, 38893

37725 (CONF-800987—1) **Leaching properties and chemical compositions of calcines produced at the Idaho Chemical Processing Plant.** Staples, B.A.; Paige, B.E.; Rhodes, D.W.; Wilding, M.W. (Exxon Nuclear Idaho Co., Inc., Idaho Falls (USA)). 1980. Contract AC07-79ID01675. 18p. NTIS, PC A02/MF A01.

From Workshop on comparative leaching behavior of radioactive waste forms; Argonne, IL, USA (3 Sep 1980).

No significant chemical differences were determined between retrieved and fresh calcine based on chemical and spectrochemical analyses. Little can be derived from the amounts of the radioisotopes present in the retrieved calcine samples other than the ratios of strontium-90 to cesium-137 are typical of aged fission product. The variations in concentrations of radionuclides within the composite samples of each bin also reflect the differences in compositions of waste solutions calcined. In general the leaching characteristics of both calcines by distilled water are similar. In both materials the radionuclides of cesium and strontium were selectively leached at significant rates, although cesium leached much more completely from the alumina calcine than from the zirconia calcine. Cesium and strontium are probably contained in both calcines as nitrate salts and also as fluoride salts in zirconia calcine, all of which are at least slightly soluble in water. Radionuclides of cerium, ruthenium, and plutonium in both calcines were highly resistant to leaching and leached at rates similar to or less than those of the matrix elements. These elements exist as polyvalent metal ions in the waste solutions before calcination and they probably form insoluble oxides and fluorides in the calcine. The relatively slow leaching of nitrate ion from zirconia calcine and radiocesium from both calcines suggests that the calcine matrix in some manner prevents complete or immediate contact of the soluble ions with water. Whether radiostrontium forms slightly fluoride salts or forms nitrate salts which are protected in the same manner as radiocesium is unknown. Nevertheless, selective leaching of cesium and strontim is retarded in some manner by the calcine matrix.

37726 (DOE/EDP—0063) **Environmental development plan. LWR commercial waste management.** (Department of Energy, Washington, DC (USA)). Aug 1980. 123p. NTIS, PC A06/MF A01.

This Environmental Development Plan (EDP) identifies the planning and managerial requirements and schedules needed to evaluate and assess the environmental, health and safety (EH and S) aspects of the Commercial Waste Management Program (CWM). Environment is defined in its broadest sense to include environmental, health (occupational and public), safety, socioeconomic, legal and institutional aspects. This plan addresses certain present and potential Federal responsibilities for the storage, treatment, transfer and disposal of radioactive waste materials produced by the nuclear power industry. The handling and disposal of LWR spent fuel and processed high-level waste (in the event reprocessing occurs) are included in this plan. Defense waste management activities, which are addressed in detail in a separate EDP, are considered only to the extent that such activities are common to the commercial waste management program. This EDP addresses three principal elements associated with the disposal of radioactive waste materials from the commercial nuclear power industry, namely Terminal Isolation Research and Development, Spent Fuel Storage and Waste Treatment Technology. The major specific concerns and requirements addressed are assurance that (1) radioactivity will be contained during waste transport, interim storage or while the waste is considered as retrievable from a repository facility, (2) the interim storage facilities will adequately isolate the radioactive material from the biosphere, (3) the terminal isolation facility will isolate the wastes from the biosphere over a time period allowing the radioactivity to decay to innocuous levels, (4) the terminal isolation mode for the waste will abbreviate the need for surveillance and institutional control by future generations, and (5) the public will accept the basic waste management strategy and geographical sites when needed.

37727 (DOE/EIS—0026(Vol.1)) **Final environmental impact statement. Waste Isolation Pilot Plant.** (Department of Energy, Washington, DC (USA). Assistant Secretary for Defense Programs). Oct 1980. 649p. NTIS, PC E08/MF E08.

In accordance with the National Environmental Policy Act (NEPA) of 1969, the US Department of Energy (DOE) has prepared this document as environmental input to future decisions regarding the Waste Isolation Pilot Plant (WIPP), which would include the disposal of transuranic waste, as currently authorized. The alternatives covered in this document are the following: (1) Continue storing transuranic (TRU) waste at the Idaho National Engineering Laboratory (INEL) as it is now or with improved confinement. (2) Proceed with WIPP at the Los Medanos site in southeastern New Mexico, as currently authorized. (3) Dispose of TRU waste in the first available repository for high-level waste. The Los Medanos site would be investigated for its potential suitability as a candidate site. This is administration policy and is the alternative preferred by the DOE. (4) Delay the WIPP to allow other candidate sites to be evaluated for TRU-waste disposal. This environmental impact statement is arranged in the following manner: Chapter 1 is an overall summary of the analysis contained in the document. Chapters 2 and 4 set forth the objectives of the national waste-management program and analyze the full spectrum of reasonable alternatives for meeting these objectives, including the WIPP. Chapter 5 presents the interim waste-acceptance criteria and waste-form alternatives for the WIPP. Chapters 6 through 13 provide a detailed description and environmental analysis of the WIPP repository and its site. Chapter 14 describes the permits and approvals necessary for the WIPP and the interactions that have taken place with Federal, State, and local authorities, and with the general public in connection with the repository. Chapter 15 analyzes the many comments received on the DEIS and tells what has been done in this FEIS in response. The appendices contain data and discussions in support of the material in the text.

37728 (DOE/EIS—0026(Vol.2)) **Final environmental impact statement. Waste Isolation Pilot Plant.** (Department of Energy, Washington, DC (USA). Assistant Secretary for Defense Programs). Oct 1980. 808p. NTIS, PC E08/MF E08.

This volume contains the appendices for the Final Environmental Impact Statement for the Waste Isolation Pilot Plant (WIPP). Alternative geologic environs are considered. Salt, crystalline rock, argillaceous rock, and tuff are discussed. Studies on alternate geologic regions for the siting of WIPP are reviewed. President Carter's message to Congress on the management of radioactive wastes and the findings and recommendations of the interagency review group on nuclear waste management are included. Selection criteria for the WIPP site including geologic, hydrologic, tectonic, physicochemical compatability, and socio-economic factors are presented. A description of the waste types and the waste processing procedures are given. Methods used to calculate radiation doses from radionuclide releases during operation are presented. A complete description of the Los Medanos site, including archaeological and historic aspects is included. Environmental monitoring programs and long-term safety analysis program are described. (DMC)

37729 (ENICO—1060) **Storage and retrievability of existing and future ICPP calcines.** Cresap, D.A. (Exxon Nuclear Idaho Co., Inc., Idaho Falls (USA)). Oct 1980. Contract AC07-79ID01675. 38p. NTIS, PC A03/MF A01.

Calcine caking and retrievability tests were conducted to ensure that calcine stored at ICPP is retrievable by conventional vacuum methods. This report describes results of shearing strength (Jenike and Johanson) tests and retrieval tests on zirconia and zirconium-sodium blended calcines. Results of Jenike tests on calcine containing phosphate and calcine containing candidate anti-caking additives are also given. All calcines tested were retrievable with standard vacuum methods and nozzle vibration at storage temperatures anticipated at ICPP.

37730 (NEDG—24749) **Alternative concepts for spent fuel storage basin expansion at Morris Operation.** Graf, W.A. Jr.; King, C.E.; Miller, G.P.; Shadel, F.H.; Sloat, R.J. (General Electric Co., San Jose, CA (USA). Nuclear Fuel and Services Div.). Aug 1980. Contract AC09-76SR00001. 263p. NTIS, PC A12/MF A01.

Alternative concepts for increasing basin capabilities for storage of spent fuel at the Morris Operation have been defined in a series of simplified flow diagrams and equipment schematics. Preliminary concepts have been outlined for (1) construction alternatives for an add-on basin, (2) high-density baskets for storage of fuel bundles or possible consolidated fuel rods in the existing or add-on basins, (3) modifications to the existing facility for increasing cask handling and fuel receiving capabilities and (4) accumulation, treatment and disposal of radwastes from storage operations. Preliminary capital and operating costs have been prepared and resource and schedule requirements for implementing the concepts have been estimated. The basin expansion alternatives would readily complement potential dry storage projects at the site in an integrated multistage program that could provide a total storage capacity of up to 7000 tonnes of spent fuel.

37731 (NVO—196-17) **Nevada Nuclear Waste Storage Investigations: Quality Assurance Plan.** (Department of Energy, Las Vegas, NV (USA). Nevada Operations Office). Aug 1980. 30p. NTIS, PC A03/MF A01.

The Nevada Nuclear Waste Storage Investigations (NNWSI) were established by DOE/NV to evaluate the geohydrologic setting and underground rock masses of the Nevada Test Site (NTS) and contiguous areas to determine whether a suitable site exists for constructing a repository for isolating highly radioactive solid wastes. Since the results of these evaluations will impact possible

risks to public health and safety, a quality assurance program which conforms to the criteria given in the Code of Federal Regulations is needed to control the quality aspects of the work. This Quality Assurance Plan (QAP) describes the general quality assurance program for the overall NNWSI project under which the quality assurance programs of the individual participating organizations and support contractors are to operate. The details of how each of these groups will meet the criteria will differ among participating organizations and support contractors, and those details are given in the QAPP's listed in Appendix A. It is the purpose of this plan to show the commonality of quality assurance programs in effect within the project and to define how each element fits into the entire picture to give total quality assurance coverage for the NNWSI Project.

37732 (ONWI—65) **Alternative waste disposal concepts. An interim technical assessment, technical report.** Crandall, D.B. (Bechtel National, Inc., San Francisco, CA (USA)). Nov 1979. Contract AC06-76RL01830. 262p. NTIS, PC A12/MF A01.

ONWI's objectives under the NWTS program are (1) to identify and develop geologic sites for use as nuclear waste repositories and (2) to manage the development and application of specific supporting data and base technologies. The investigation and evaluation of alternative waste disposal technologies is required to satisfy the second objective and to comply with the NEPA process. The study (1) provides a preliminary identification and description of alternative waste disposal concepts, (2) combines them selectively with particular forms of spent fuel and waste into specific cases, and (3) provides a preliminary comparative assessment of the cases with respect to radiological impact, environmental impact, degree of development, resource consumption, safeguards, and economics. This report provides a tentative ranking of the cases studied, based on the assessments made, and contains recommendations for additional work required to provide a more thorough definition of disposal concepts and a means for developing final evaluations of the alternatives.

37733 (ORNL/EIS—156/V1) **Selected, annotated bibliography of studies relevant to the isolation of nuclear wastes.** Hyder, L.K.; Fore, C.S.; Vaughan, N.D.; Faust, R.A. (Oak Ridge National Lab., TN (USA)). Sep 1980. Contract W-7405-ENG-26. 459p. NTIS, PC A20/MF A01.

This annotated bibliography of 705 references represents the first in a series to be published by the Ecological Sciences Information Center containing scientific, technical, economic, and regulatory information relevant to nuclear waste isolation. Most references discuss deep geologic disposal, with fewer studies of deep seabed disposal; space disposal is also included. The publication covers both domestic and foreign literature for the period 1954 to 1980. Major chapters selected are Chemical and Physical Aspects; Container Design and Performance; Disposal Site; Envirnmental Transport; General Studies and Reviews; Geology, Hydrology and Site Resources; Regulatory and Economic Aspects; Repository Design and Engineering; Transportation Technology; Waste Production; and Waste Treatment. Specialized data fields have been incorporated to improve the ease and accuracy of locating pertinent references. Specific radionuclides for which data are presented are listed in the Measured Radionuclides field, and specific parameters which affect the migration of these radionuclides are presented in the Measured Parameters field. The references within each chapter are arranged alphabetically by leading author, corporate affiliation, or title of the document. When the author is not given, the corporate affiliation appears first. If these two levels of authorship are not given, the title of the document is used as the identifying level. Indexes are provided for author(s), keywords, subject category, title, geographic location, measured parameters, measured radionuclides, and publication description.

37734 (PB—80-138993) **Summary report on the low-level radioactive waste burial site, West Valley, New York (1963-1975).** Giardina, P.A.; DeBonis, M.F.; Eng, J.; Meyer, G.L. (Environmental Protection Agency, New York (USA). Region II). Oct 1977. 136p. NTIS, PC A07/MF A01.

The purpose of this report is to take the information gathered in the lithological boring study along with information from other pertinent studies performed on the West Valley low-level radioactive waste burial site through March 1975 and examine the several pathways, actual and potential, for radioactivity to move from the site. Using the same information an examination of the status of this site will be compared with recommendations made for low-level nuclear waste disposal sites and hazardous material disposal sites. Possible improvements in the areas of the site selection, development, and operation to reduce environmental impacts of this and similar sites will be recommended. Finally, follow up studies that are either needed or being performed will be described.

37735 (RHO-BWI—80-100-3Q) **Basalt Waste Isolation Project. Quarterly report, April 1, 1980-June 30, 1980.** (Rockwell International Corp., Canoga Park, CA (USA). Energy Systems Group). Jul 1980. Contract AC06-77RL01030. 74p. NTIS, PC A04/MF A01.

Progress is reported in the following work areas: systems integration, geosciences, hydrology, engineered barriers, near-surface test facility, engineering testing, and repository studies. (DLC)

37736 (RHO-BWI-C—62(Vol.1)) **Site locality identification study: Hanford Site. Volume I. Methodology, guidelines, and screening.** (Woodward-Clyde Consultants, San Francisco, CA (USA)). Jul 1980. Contract AC06-77RL01030. 194p. NTIS, PC A09/MF A01.

Presented in this report are the results of the site locality identification study for the Hanford Site using a screening process. To enable evaluation of the entire Hanford Site, the screening process was applied to a somewhat larger area; i.e., the Pasco Basin. The study consisted of a series of screening steps that progressively focused on smaller areas which are within the Hanford Site and which had a higher potential for containing suitable repository sites for nuclear waste than the areas not included for further study. Five site localities, designated H-1, H-2, H-3, H-4, H-5 (Figure A), varying in size from approximately 10 to 50 square miles, were identified on the Hanford Site. It is anticipated that each site locality may contain one or more candidate sites suitable for a nuclear waste repository. The site locality identification study began with definition of objectives and the development of guidelines for screening. Three objectives were defined: (1) maximize public health and safety; (2) minimize adverse environmental and socioeconomic impacts; and (3) minimize system costs. The screening guidelines have numerical values that provided the basis for the successive reduction of the area under study and to focus on smaller areas that had a higher likelihood of containing suitable sites.

37737 (RHO-BWI-C—62(Vol.2)) **Site locality identification study: Hanford Site. Volume II. Data cataloging.** (Woodward-Clyde Consultants, San Francisco, CA (USA)). Jul 1980. Contract AC06-77RL01030. 199p. NTIS, PC A09/MF A01.

Data compilation and cataloging for the candidate site locality identification study were conducted in order to provide a retrievable data cataloging system for the present siting study and future site evaluation and licensng processes. This task occurred concurrently with and also independently of other tasks of the candidate site locality identification study. Work in this task provided the data utilized primarily in the development and application of screening and ranking processes to identify candidate site localities on the Hanford Site. The overall approach included two steps: (1) data acquisition and screening; and (2) data compilation and cataloging. Data acquisition and screening formed the basis for preliminary review of data sources with respect to their probable utilization in the candidate site locality identification study and review with respect to the level of completeness and detail of the data. The important working assumption was that the data to be used in the study be based on existing and available published and unpublished literature. The data compilation and cataloging provided the basic product of the Task; a retrievable data cataloging system in the form of an annotated reference list and key word index and an index of compiled data. The annotated reference list and key word index are cross referenced and can be used to trace and retrieve the data sources utilized in the candidate site locality identification study.

37738 (RHO-BWI-C—66) **Preliminary geochemical and physical testing of materials for plugging of man-made accesses to a repository in basalt.** Taylor, C.L.; Anttonen, G.J.; O'Rourke, J.E.; Allirot, D. (Woodward-Clyde Consultants, San Francisco, CA (USA)). Apr 1980. Contract AC06-77RL01030. 398p. NTIS, PC A17/MF A01.

The available data on environmental conditions (both natural and man-made) at the Hanford Site are sufficient for preconceptual plug system design. Results of the geochemical testing program indicate that preferred candidate plug materials are chemically nonreactive during laboratory tests that simulated some of the expected environmental conditions. Agitated, crushed-basalt samples and mixtures containing basalt were found to be self-cementing under the hydrothermal conditions. Materials considered most suitable for consideration in future test programs and preconceptual plug design are mixtures of natural materials (basalt, clay, glaciofluvial sand, gravel, and zeolite) and processed natural materials (portland cement Type V and grouts plus additives).

37739 (RHO-BWI-SA—66) **Evaluation of preconceptual plug designs using experts' judgement.** Sioshansi, F.P.; O'Rourke, J.E. (Woodward-Clyde Consultants, San Francisco, CA (USA)). Mar 1980. Contract AC06-77RL01030. 35p. (CONF-801106—1). NTIS, PC A03/MF A01.

From American Institute for Decision Sciences conference; Las Vegas, NV, USA (5 Nov 1980).

A number of preconceptual plug designs for an underground nuclear waste repository were to be evaluated based on the available information on plug materials and placement techniques. Because of complex environment and loading conditions, long time frame under consideration, rigid performance characteristics and considerable uncertainties present in preconceptual design and material properties, a qualitative and judgmental evaluation procedure was needed to supplement technical studies. A structured procedure was devel-

oped to qualitatively capture evaluator's views and reservations on the proposed preconceptual schemes. Since a thorough evaluation of each proposed plug scheme required in-depth experience and familiarity with many components of the plug, three knowledgeable experts with specialties in the most relevant aspects of the problem were independently interviewed. Each plug scheme was broken down into three subcomponents and each subcomponent was evaluated separately. The proposed schemes were then rated taking their subcomponents into consideration. Because the experts had different specialties, their subcomponent and overall ratings were not in full agreement. Each plug scheme's lowest overall rating was used as the most significant determinant of the judgmental preference categories reported in this study. The approach used discriminated between the proposed schemes for those with highest probability of being successful. The most preferred schemes were then reviewed with respect to the data produced in the technical analysis performed during the project. The results of the judgmental analysis were then synthesized and modified with results of the technical analysis to produce the preconceptual plug designs.

37740 (SAND—80-1599C) **Technical developments in the WIPP program.** Weart, W.D. (Sandia Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 37p. (CONF-801077—1). NTIS, PC A03/MF A01.

From Association of Engineering Geologists annual meeting; Dallas, TX, USA (20 Oct 1980).

More than five years of site specific studies have led to the conclusion that radioactive wastes can be safely isolated in the bedded salt of the Delaware Basin in southeast New Mexico. Aspects of particular concern for site integrity, such as regional or local dissolution processes and salt deformation have been thoroughly evaluated and are not believed to present hazards to the repository. Hydrology of the site area has been shown to possess many desirable features with respect to transport of radioisotopes to the bioshpere in the event of a repository breach. Natural resources, potash and hydrocarbons, are present in the area of the site but can be exploited with appropriate precautions. Safety analyses have considered the consequences of their possible attraction to future man. Repository behavior and interactions between waste and the host rock have been studied in the laboratory, in field tests and by calculational methods. In particular, such issues as brine migration and canister corrosion may be shown to have little detrimental impact if modest and practical engineering measures are adopted. Calculations indicate salt deformation and room closure rates may be great enough that a salt repository must be carefully designed in order to assure ready retrieval of emplaced waste over long periods of time. Safety assessment calculations have been performed to determine the consequences of assumed repository failure scenarios. Even the most dire credible (but improbable) natural failure scenarios prove to be benign in their consequences to man. Direct penetration by unknowing, future man could result in significant exposures to the specific individuals involved but would not cause significant population effects.

37741 (UCID—18681) **Effects of dimensionality and boundary conditions on thermal calculations.** Thorson, L.D.; Montan, D.N. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 29 Sep 1980. Contract W-7405-ENG-48. 19p. NTIS, PC A02/MF A01.

We consider several aspects of the thermal modeling of an underground nuclear waste repository. These are the long term temperature response due to different ground surface boundary conditions, the effects of treating the three-dimensional problem in 2-D, and the consequences of using a constant power load rather than decaying power typical of radioactive waste. Our approach is superposition in time and space of the appropriate analytic solutions.

37742 (USGS-OFR—80-929) **Preliminary interpretations of geologic results obtained from boreholes UE25a-4, -5, -6, and -7, Yucca Mountain, Nevada Test Site.** Spengler, R.W.; Rosenbaum, J.G. (Geological Survey, Reston, VA (USA)). 1980. Contract AI08-78ET44802. 39p. NTIS, PC A03/MF A01.

Since 1978, the USGS (US Geological Survey) has been providing technical assistance in characterizing suitable rock masses at or contiguous to the NTS (Nevada Test Site) for long-term storage of high-level nuclear waste. Current efforts have been focused on investigating Yucca Mountain, a volcanic highland situated along the western boundary of NTS in southern Nevada. Detailed stratigraphic and structural studies have been in progress along a northeastern segment of the highland in a wedge-shaped area bounded by Basin and Range faults, most of which trend north-northeast. A series of four locally steep-walled, nearly parallel, linear washes transect the northeastern half of the area of interest and display trends similar to major faults to the northeast. Prior to the present study, drill hole UE25a-1, located about 1600 feet southeast of the edge of the area of interest, was cored to a depth of 2500 feet. Subsurface information derived from the upper 500 feet of this drill hole is included in this report to compare with recently acquired data. Surface electrical surveys have been conducted by both the University of Utah and the USGS perpendicular to the trend of the washes in an attempt to better understand factors that have influenced the present drainage pattern. Preliminary data of both pole-dipole and dipole-dipole resistivity/IP electrical methods indicate numerous vertical and horizontal discontinuities between adjacent resistive bodies that strongly suggest a broad zone of faulting, fracturing, and (or) brecciation. To verify the existence of structural discontinuities suggested by the linear washes and electrical anomalies, a drilling program was initiated in June 1979, to obtain geologic information within the southernmost of four northwest-trending washes.

37743 **Store for nuclear reactor fuel elements.** Peehs, M. (to Kraftwerk Union A.G., Muelheim an der Ruhr (Germany, F.R.); Deutsches Patentamt, Muenchen (Germany, F.R.)). German(FRG) Patent 2,823,376/B/. 13 Sep 1979. 8p. (In German).

The spent fuel elements are preserved in a pond or dry store. The removal of post-fission heat is carried out via heat removal pipes, which are connected to natural draught chimneys through the concrete wall of the pond or dry store. There is a good conducting connection of the heat removal pipes and the storage boxes, which is improved by filling the space between the fuel elements and the storage box with granular carbon.

37744 **Pilot heater test of the Swedish Nuclear Fuel Safety Program.** Carlsson, H.; Stephanson, O.; Leijon, B. (Univ of Lulea, Swed). pp 85-90 of Fourth international congress on rock mechanics. Vol. 1. Salem, NH; A.A. Balkema (1979).

From 4. international congress on rock mechanics; Montreux, Switzerland (2 Sep 1979).

In the Stripa mine in Sweden, a pilot heater test has been carried out at 348 m level in a jointed granite. A central main heater was placed at the bottom of a 10 m deep borehole. At different distances from the heater, stress and temperature changes were monitored. Measurements of movements along major fractures on the surface and changes of water inflow in boreholes were also carried out. 6 refs.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 37669, 37687, 37689, 37690, 37726, 37727, 37728, 38404, 38703, 38704, 38705, 38707, 38711, 38841

37745 (ENICO—1054) **Continuous plutonium monitor for nuclear facility off-gas streams.** McDonald, F.N.; Fernandez, S.J.; Motes, B.G. (Exxon Nuclear Idaho Co., Inc., Idaho Falls (USA)). Oct 1980. Contract AC07-79ID01675. 40p. NTIS, PC A03/MF A01.

This document is the final report of the project to develop a continuous, real-line monitor for ICPP plutonium emissions in the presence of naturally occurring radon daughters. The developed monitor collects the plutonium sample on a glass fiber filter followed by in-situ x-ray spectroscopy. The monitor was developed in two phases; laboratory testing and on-line demonstration. The major conclusions were the following: A Low-Energy Photon Spectrometer (LEPS) had sufficient sensitivity and resolution to detect the 40 hour occupational plutonium limit of 2 x 10^{-6} pCi/cc in 24 hours. There were no detectable biases or inaccuracies due to unattended operation of the monitor. Therefore, the continuous plutonium monitor was deemed to be suitable for ICPP off-gas streams.

37746 (ORNL—5567) **FEMWATER: a finite-element model of water flow through saturated-unsaturated porous media.** Yeh, G.T.; Ward, D.S. (Oak Ridge National Lab., TN (USA)). Oct 1980. Contract W-7405-ENG-26. 162p. NTIS, PC A08/MF A01.

Upon examining the Water Movement Through Saturated-Unsaturated Porous Media: A Finite-Element Galerkin Model, it was felt that the model should be modified and expanded. The modification is made in calculating the flow field in a manner consistent with the finite element approach, in evaluating the moisture-content increasing rate within the region of interest, and in numerically computing the nonlinear terms. With these modifications, the flow field is continuous everywhere in the flow regime, including element boundaries and nodal points, and the mass loss through boundaries is much reduced. Expansion is made to include four additional numerical schemes which would be more appropriate for many situations. Also, to save computer storage, all arrays pertaining to the boundary condition information are compressed to smaller dimension, and to ease the treatment of different problems, all arrays are variably dimensioned in all subroutines. This report is intended to document these efforts. In addition, in the derivation of finite-element equations, matrix component representation is used, which is believed more readable than the matrix representation in its entirety. Two identical sample problems are simulated to show the difference between the original and revised models.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 37699, 38705, 38841

REGULATIONS

ACCOUNTABILITY AND SAFEGUARDS

REFER ALSO TO CITATION(S) 37695, 38548

37747 (ANL—80-70) **Preliminary study: isotopic safeguards techniques (IST). LMFBR fuel cycles.** Persiani, P.J.; Kroc, T.K. (Argonne National Lab., IL (USA)). Jun 1980. Contract W-31-109-ENG-38. 154p. NTIS, PC A08/MF A01.

This memorandum presents the preliminary results of the effort to investigate the applicability of isotope correlation techniques (ICT), formulated for the LWR system, to the LMFBR fuel cycle. The detailed isotopic compositional changes with burnup developed for the CRBR was utilized as the reference case. This differs from the usual LMFBR design studies in that the core uranium is natural uranium rather than depleted. Nevertheless, the general isotopic behavior should not differ significantly and does allow an initial insight into the expected behavior of isotopic correlations for the LMFBR power systems such as: the U.K. PFR and reprocessing plant; the French Phenix and Superphenix; and the US reference conceptual design studies (CDS) of homogeneous and heterogeneous LMFBR systems as they are developed.

37748 (CONF-801107—13) **Criticality and safeguards at the Idaho Chemical Processing Plant.** Kodman, G.P.; Wilson, R.E. (EG and G Idaho, Inc., Idaho Falls (USA)). 1980. Contract AC07-79ID01675. 7p. NTIS, PC A02/MF A01.

From ANS international conference; Washington, DC, USA (17 Nov 1980).

Reprocessing of high enriched irradiated reactor fuel at the Idaho Chemical Processing Plant (ICPP) presents significant potential problems to the Criticality Safety (CS) and Safeguards & Security (S & S) Sections. Two major interactions between these sections occurs when irradiated fuel is stored and fuel is dissolved. S & S is assigned the responsibility of maintaining a centralized records and reporting system which provides detailed, timely knowledge of the location, quantity and measurement uncertainties associated with accountable nuclear material, including uranium and plutonium. The Criticality Safety Section uses this information in providing criticality safety evaluations with support analyses, inspection, field surveillance and audits to ensure criticality safety implementation. The interactions of these sections has minimized operational constraints and maximized criticality safeguards controls.

37749 (LA—8194-M) **CMB-8 material balance system.** Langner, D.; Canada, T.; Ensslin, N.; Atwell, T.; Baxman, H.; Cowder, L.; Speir, L.; Lyssel, T.V.; Sampson, T. (Los Alamos Scientific Lab., NM (USA)). Aug 1980. Contract W-7405-ENG-36. 189p. NTIS, PC A09/MF A01.

We describe the automated nondestructive assay (NDA) system installed at the Los Alamos Scientific Laboratory (LASL) Group CMB-8 uranium recovery facility. A random driver (RD) is used to measure the ^{235}U content of various solids while a uranium solution assay system (USAS) measures the ^{235}U or total uranium content of solutions over a concentration range of a few ppM to 400 g/l. Both instruments are interfaced to and controlled by a single minicomputer. The measurement principles, mechanical specifications, system software description, and operational instructions are described.

37750 (LA—8373-PR) **Nuclear Safeguards Research and Development program status report, January-March 1980.** Keepin, G.R. (ed.). (Los Alamos Scientific Lab., NM (USA)). Sep 1980. Contract W-7405-ENG-36. 73p. NTIS, PC A04/MF A01.

This report presents the status of the Nuclear Safeguards Research and Development program pursued by the Los Alamos Scientific Laboratory Safeguards Groups Q-1, Q-2, Q-3, Q-4, Q-5, and CMB-1. Topics covered include nondestructive assay technology development and applications, international safeguards, perimeter safeguards and surveillance, concepts and subsystems development, integrated safeguards systems, training courses, technology transfer, and analytical chemistry methods for fissionable materials safeguards.

37751 (LA—8545-PR) **Evaluation of in-line nondestructive assay systems. Progress report, April 1-June 30, 1980.** Bowersox, D.F.; Ensslin, N.; Hsue, S.T.; Johnson, S.S.; Parker, J.L.; Sampson, T.E. (Los Alamos Scientific Lab., NM (USA)). Sep 1980. Contract W-7405-ENG-36. 17p. NTIS, PC A02/MF A01.

The determination of total plutonium contents of oxides by gamma spectroscopy and calorimetry or neutron coincidence counting is being studied.

37752 (SAND—80-0445) **Performance estimates for personnel access control systems.** Bradley, R.G. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1980. Contract AC04-76DP00789. 20p. NTIS, PC A02/MF A01.

Current performance estimates for personnel access control systems use estimates of Type I and Type II verification errors. A system performance equation which addresses normal operation, the insider, and outside adversary attack is developed. Examination of this equation reveals the inadequacy of classical Type I and II error evaluations which require detailed knowledge of the adversary threat scenario for each specific installation. Consequently, new performance measures which are consistent with the performance equation and independent of the threat are developed as an aid in selecting personnel access control systems.

37753 **Proceedings of 20th annual meeting of Institute of Nuclear Materials Management, 1979.** (Inst of Nucl Mater Manage, Piketon, Ohio). *Nucl. Mater. Manage.;* **8**: vp(1979).

The proceedings contain 83 papers, of which 72 are indexed separately. In general, papers deal with the field of nuclear materials management. Various aspects of safeguard systems are presented and new instrumentation and surveillance systems are discussed.

37754 **Formal training program for nuclear material custodians at Hanford Engineering Development Laboratory.** Scott, D.D. (Westinghouse Hanford Co, Richland, Wash). *Nucl. Mater. Manage.;* **8**: 88-92(1979).

Hanford Engineering Development Laboratory (HEDL) has established a formal training program for nuclear material (NM) custodians. The program, designed to familiarize the custodian with the fundamental concepts of proper nuclear materials control and accountability, is conducted on a semiannual basis. The program is prepared and presented by the Safeguards and Materials Management Section of HEDL and covers 14 subjects on accountability, documentation, transportation, custodian responsibilities, and the safeguarding of nuclear material.

37755 **Practical results from a mathematical analysis of guard patrols.** Indusi, J.P. (Brookhaven Natl Lab, Upton, NY). *Nucl. Mater. Manage.;* **8**: 100-107(1979).

Using guard patrols as a primary detection mechanism is not generally viewed as a highly efficient detection method when compared to electronic means. Many factors such as visibility, alertness, and the space-time concidence of guard and adversary presence all have an effect on the probability of detection. Mathematical analysis of the guard patrol detection problem is related to that of classical search theory originally developed for naval search operations. The results of this analysis tend to support the current practice of using guard forces to assess and respond to previously detected intrusions and not as the primary detection mechanism. 6 refs.

37756 **Nondestructive measurement of plutonium.** Gibbs, A.; Belew, W.L. (DuPont, Aiken, SC). *Nucl. Mater. Manage.;* **8**: 148-154(1979).

Proposed U.S. Department of Energy orders require measurement of the amount of plutonium in shipments between sites more rapidly than is normally possible using conventional destructive analysis techniques. Assay of plutonium shipments received at the Savannah River Plant (SRP) has been accomplished nondestructively using neutron counting, calirometry, and gamma spectrometry. 2 refs.

37757 **Use of process monitoring data for enhancement of nuclear material control and accounting.** Miles, J.C.; Glancy, J.E.; Donelson, S.E. (Monsanto Res Corp, Miamisburg, Ohio). *Nucl. Mater. Manage.;* **8**: 264-271(1979).

A study was performed for the United States Nuclear Regulatory Commission to determine whether existing process monitoring data recorded by licensees can be used in conjunction with present material accounting systems to increase the effectiveness of safeguarding special nuclear materials. Two licensed fuel fabrication facilities were examined. The results show that significant improvements are obtainable in timeliness of loss detection, mass sensitivity for loss detection, and localization of detected loss to specific materials by the utilization of process monitoring data. The cost for implementation to obtain these improvements is nominal because the measurements already exist. 2 refs.

37758 **Application of controllable unit approach (CUA) to performance-criterion-based nuclear material control and accounting.** Foster, K.W.; Rogers, D.R. (Monsanto Res Corp, Miamisburg, Ohio). *Nucl. Mater. Manage.;* **8**: 272-277(1979).

The Nuclear Regulatory Commission is considering the use of maximum-loss performance criteria as a means of controlling SNM in nuclear plants. The Controllable Unit Approach to material control and accounting (CUA) was developed by Mound to determine the feasibility of controlling a plant to a performance criterion. The concept was tested with the proposed Anderson, SC, mixed-oxide plant, and it was shown that CUA is indeed a feasible method

for controlling a complex process to a performance criterion. The application of CUA to an actual low-enrichment plant to assist the NRC in establishing performance criteria for uranium processes is discussed. 5 refs.

37759 Estimated incremental costs for NRC licensees to implement the US/IAEA safeguards agreement. Clark, R.G.; Brouns, R.J.; Chockie, A.D.; Davenport, L.C.; Merrill, J.A. (Pac Northwest Lab, Richland, Wash). *Nucl. Mater. Manage.;* **8**: 308-314(1979).

A study was recently completed for the U.S. Nuclear Regulatory Commission (NRC) by the Pacific Northwest Laboratory (PNL) to identify the incremental cost to eligible NRC licensees of implementing the US/IAEA safeguards treaty agreement. The costs developed by PNL in this study resulted from reviewing and consolidating estimates provided by more than 20 NRC licensees representing ten facility types. 7 refs.

37760 Proliferation resistance engineering: a recent study. Kofoed, R.J.; Sorenson, R.J.; Roberts, F.P.; Schuller, C.R. (Battelle, Pac Northwest Lab, Richland, Wash). *Nucl. Mater. Manage.;* **8**: 315-325(1979).

Proliferation resistance engineering (PRE) concepts have been developed to counter the threat of proliferation of nuclear weapons in an International Fuel Service Center (IFSC). These concepts include passive use-denial, active use-denial, and command, control and communication center. These concepts have been developed under sponsorship of the Nonproliferation Alternative Systems Assessment Program (NASAP) to determine the plausibility of the concepts to counter the threat of proliferation. In addition, the political and institutional issues relating to an IFSC were evaluated and conclusions were developed. 1 ref.

37761 Development of a computerized nuclear materials control and accounting system for a fuel reprocessing plant. Crawford, J.M.; Ehinger, M.H.; Joseph, C.; Madeen, M.L. (Allied-Gen Nucl Serv, Barnwell, SC). *Nucl. Mater. Manage.;* **8**: 405-428(1979).

A computerized nuclear materials control and accounting system (CNMCAS) for a fuel reprocessing plant is being developed by Allied-General Nuclear Services at the Barnwell Nuclear Fuel Plant. Development work includes on-line demonstration of near real-time measurement, measurement control, accounting, and processing monitoring/process surveillance activities during test process runs using natural uranium. A technique for estimating in-process inventory is also being developed. This paper describes development work performed and planned, plus significant design features required to integrate CNMCAS into an advanced safeguards system. 2 refs.

37762 Optimal use of loss estimators for detecting diversion. Hostetler, D.E. (DuPont, Aiken, SC). *Nucl. Mater. Manage.;* **8**: 495-506(1979).

The usual loss estimators used for detecting the loss or diversion of special nuclear material are effective only for specific diversion strategies. An alternate detection method is available which provides optimum protection against the unknown diversion strategy by looking at all possible contiguous sequences of balances. A new technique is described for setting alarm limits and defining detector sensitivities for this alternate method. The effectiveness of this method is then compared with several of the conventional loss estimators. 4 refs.

37763 Peer review of strategic analysis of material accounting. Opelka, J.H.; Bennett, C.A.; Goldman, A.J.; Higinbotham, W.A.; Jaech, J.L.; Lucas, W.F.; Lumb, R.F. (Argonne Natl Lab, Ill). *Nucl. Mater. Manage.;* **8**: 507-514(1979).

A Peer Review Group knowledgeable about game theory and safeguards was organized to assess the utility of strategic analysis for analyzing inventory differences in particular and safeguards events in general. The group concluded that game theory may provide a useful basis for arriving at safeguards decisions, and could be a complementary--not alternative--tool to statistical analysis. The group recommended further development of game theory in areas of potential application.

37764 Statistical approach to simultaneous tests for both short term and long term material losses. Merrill, J.A.; Brouns, R.J. (Pac Northwest Lab, Richland, Wash). *Nucl. Mater. Manage.;* **8**: 515-527(1979).

The current method of testing the inventory difference (ID) for each material balance period is not a very powerful procedure for detecting a continuing loss when the amount lost during each period is quite small. There is a need for action limit criteria using information such as cumulative inventory differences (CID) to enhance the probability of detection for such situations. This paper presents a method for making a single multivariate test using both ID and CID which will permit the calculation of power curves for the test. 6 refs.

37765 Redundant measurements for controlling errors. Ehringer, M.H.; Crawford, J.M.; Madeen, M.L. (Allied-Gen Nucl Serv, Barnwell, SC). *Nucl. Mater. Manage.;* **8**: 564-572(1979).

Current federal regulations for nuclear materials control require consideration of operating data as part of the quality control program and limits of error propagation. Recent work at the BNFP has revealed that operating data are subject to a number of measurement problems which are very difficult to detect and even more difficult to correct in a timely manner. Error estimates based on operational data reflect those problems. During the FY 1978 and FY 1979 R and D demonstration runs at the BNFP, redundant measurement techniques were shown to be effective in detecting these problems to allow corrective action. The net effect is a reduction in measurement errors and a significant increase in measurement sensitivity. Results show that normal operation process control measurements, in conjunction with routine accountability measurements, are sensitive problem indicators when incorporated in a redundant measurement program.

37766 Measurement control program for a conversion-fabrication plant. Schneider, R.A.; Wing, N.S.; Baker, W.A.; Jaech, J.L.; Johnson, K.O. (Exxon Nucl Co, Richland, Wash). *Nucl. Mater. Manage.;* **8**: 573-592(1979).

A measurement control program for a low enriched conversion-fabrication plant for LWR fuels is described. The program is used to control and estimate the volume, weight, U-element, and U-235 measurement errors. The principles and practical aspects of establishing a system of standards, replicate measurements, calibrations, and statistical applications are discussed. Engineering scale experimental approaches for estimating systematic sampling errors and the waste materials matrix bias for the passive gamma counting of U-235 in solid waste are also described. 7 refs.

37767 Personnel portal for international research facilities safeguards. Mangan, D.L. (Sandia Lab, Albuquerque, NM). *Nucl. Mater. Manage.;* **8**: 674-680(1979).

The design of a portal developed as part of an advanced international containment and surveillance system concept for fast critical facilities is discussed. Pertinent features of the neutron, gamma, and metal detection elements are enumerated, and the uselogic of the microprocessor based system is examined. Tamper-safe features of the portal are presented, and the system for presenting data to an inspector is reviewed. The portal capabilities are discussed. 9 refs.

ADMINISTRATIVE AND REGULATORY

REFER ALSO TO CITATION(S) 37754

FUSION FUELS

FUSION FUELS

PROCESSING

FABRICATION AND TESTING

37768 (UCRL—84463) **Metallic coating of microspheres.** Meyer, S.F. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 15 Aug 1980. Contract W-7405-ENG-48. 34p. (CONF-801037—20). NTIS, PC A03/MF A01.

From American Vacuum Society conference; Detroit, MI, USA (13 Oct 1980).

Extremely smooth, uniform metal coatings of micrometer thicknesses on microscopic glass spheres (microspheres) are often needed as targets for inertial confinement fusion (ICF) experiments. The first part of this paper reviews those methods used successfully to provide metal coated microspheres for ICF targets, including magnetron sputtering, electro- and electroless plating, and chemical vapor pyrolysis. The second part of this paper discusses some of the critical aspects of magnetron sputter coating of microspheres, including substrate requirements, the sticking of microspheres during coating (preventing a uniform coating), and the difficulties in growing the desired dense, smooth, uniform microstructure on continuously moving spherical substrates.

37769 (UCRL—84464) **Addition of bromine as a diagnostic gas to inertial confinement fusion target microspheres.** Morrison, R.L. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 22 Aug 1980. Contract W-7405-ENG-48. 8p. (CONF-801037—15). NTIS, PC A02/MF A01.

From American Vacuum Society conference; Detroit, MI, USA (13 Oct 1980).

Currently, direct fuel rho r measurements on Inertial Confinement Fusion (ICF) targets by neutron activation of the argon tracer gas mixed with the DT fuel would require a 100 fold increase in neutron yield. Bromine, on the other hand, has excellent properties for neutron activation analysis at neutron yields of 10twoʻ to 10^8, when present at an internal pressure of from 0.1 to 0.2 atmospheres. Bromine addition is accomplished in a 2 furnace system using the dried-gel method of microsphere production. An upper furnace operated at 1500°C is separated from a lower furnace by a cooled zone. The lower furnace is filled with bromine gas and operated at approximately 1250°C. The upper furnace is the glass production furnace. The cooled zone in between the upper and lower furnace is to prevent the hot bromine gas from rising into the upper furnace. The microspheres pass through the cooled zone and immediately into the 1250°C bromine furnace where the bromine permeates into the spheres.

37770 (UCRL—84478) **Recent advances in Pt coating of microspheres by a batch magnetron sputtering process.** Hsieh, E.J.; Meyer, S.F. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 29 Aug 1980. Contract W-7405-ENG-48. 17p. (CONF-801037—19). NTIS, PC A02/MF A01.

From American Vacuum Society conference; Detroit, MI, USA (13 Oct 1980).

Some proposed inertial confinement fusion targets require high-Z, high density metal coatings on glass microspheres. Platinum, which satisfies the high-Z and density requirements, can be coated onto microspheres with a batch magnetron sputtering process incorporating oxygen as a dopant gas to prevent the microspheres from sticking. This paper outlines recent progress in three areas: First, the coating process has been improved; second, the oxygen content and resistivity of the oxygen doped platinum films are analyzed; and third, the roles oxygen may play in reducing microsphere sticking during sputtering are discussed in regard to cold welding, Van der Waals bonding, electrostatic sticking, and sintering.

BY-PRODUCTS

37771 (BNL—51188) **Proceedings of Brookhaven National Laboratory's fusion/synfuel workshop.** Fillo, J.A.; Powell, J.R. (eds.). (Brookhaven National Lab., Upton, NY (USA)). 1979. Contract AC02-76CH00016. 136p. (CONF-7908127—). NTIS, PC A07/MF A01.

From Brookhaven National Laboratory's fusion/synfuel workshop; Upton, NY, USA (27 Aug 1979).

The fusion synfuels workshop held at Brookhaven National Laboratory (BNL) on August 27-29, 1979 examined the current status of candidate synfuel processes and the R and D required to develop the capability for fusion synfuel production. Participants divided into five working groups, covering the following areas: (1) economics and applications; (2) high-temperature electrolysis; (3) thermochemical processes (including hybrid thermo-electrochemical); (4) blanket and materials; and (5) high-efficiency power cycles. Each working group presented a summary of their conclusions and recommendations to all participants during the third day of the Workshop. These summaries are given.

PROPERTIES

REFER ALSO TO CITATION(S) 38355

ENVIRONMENTAL ASPECTS

37772 **Assay of tritium-filled glass microspheres by liquid scintillation counting.** Campbell, G.W.; Anderson, A.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). *Health Phys.;* **38**: No. 2, 232-234(Feb 1980).

At Lawrence Livermore Laboratory tritium-filled glass microspheres are used as fuel for the laser fusion facility. Microspheres sometimes break into small airborne fragments that present a possible inhalation hazard, and standard air samplers are used to monitor the workplaces where they are handled. A segment is removed from each filter paper, placed directly into liquid scintillation cocktail and counted for 10 min. Total tritium activity present is then calculated. Tritium concentrations several orders of magnitude below the calculated MPC are readily detected. This method involves counting the activity from β-particles with sufficient energy to escape the glass of fragments or intact microspheres, thus β-particles that contribute to the lung dose, not to the total activity in the glass, are measured. To validate the counting procedure and to compare the results with those of previous calculations, the fraction of β-particles escaping glass fragments was determined experimentally by counting the activity per gram of crushed microsphere samples with and without filter paper segments. It is concluded that the method described can give an accuracy of within +-50% on a routine basis.

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

37773 (MLM—2718) **Stable isotope sales: Mound Facility customer and shipment summaries, FY 1979.** Ruwe, A.H. Jr. (comp.). (Mound Facility, Miamisburg, OH (USA)). 24 Oct 1980. Contract AC04-76DP00053. 25p. NTIS, PC A02/MF A01.

A listing is given of Mound Facility's sales of stable isotopes of noble gases, carbon, oxygen, nitrogen, chlorine, and sulfur for Fiscal Year 1979. Purchasers are listed alphabetically and are divided into domestic and foreign groups. A cross-reference index by location is included for domestic customers. Cross-reference listings by isotope purchased are included for all customers.

PHYSICAL ISOTOPE SEPARATION

37774 (CONF-800870—1) **Helium-jet coupled mass separator: advances and directions.** Moltz, D.M. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 9p. NTIS, PC A02/MF A01.

From 10. international conference on electromagnetic isotope separators; Zinal, Switzerland (31 Aug 1980).

Results from the RAMA-88 system at the Lawrence Berkeley Laboratory are being used to design a new helium-jet and ion source system for the UNISOR project. This system should complement the existing integrated target-ion source to extend UNISOR's capabilities to include a majority of the chemical elements. This fast transport helium-jet system should permit studies of nuclides with half-lives down to 50 ms.

RADIATION SOURCES

DESIGN AND FABRICATION

37775 (SAND—80-1571C) **Pulsed neutron generator for use with pulsed neutron activation techniques.** Rochau, G.E. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 16p. (CONF-800747—1). NTIS, PC A02/MF A01.

From Review group conference on advanced instrumentation for reactor safety research; Oak Ridge, TN, USA (29 Jul 1980).

A high-output, transportable, pulsed neutron generator has been developed by Sandia National Laboratories for use with Pulsed Neutron Activation (PNA) techniques. The PNA neutron generator generates $>10^{10}$ 14 MeV D-T neutrons in a 1.2 millisecond pulse. The PNA neutron generator tested performed according to specifications. (LCL)

USE IN FOOD PROCESSING

REFER ALSO TO CITATION(S) 37776

OTHER INDUSTRIAL USES

37776 (SAND—80-1466) **Beneficial uses program. Progress report, period ending March 31, 1980.** (Sandia National Labs., Albuquerque, NM (USA)). Aug 1980. Contract AC04-76DP00789. 70p. NTIS, PC A04/MF A01.

Progress is reported on dried sewage sludge irradiation, on irradiated sludge use as cattle feed, the inactivation of enteric organisms, the use of irradiation for citrus fruit disinfestation, and the effects of sludge addition on herbicide behavior in soils under laboratory conditions. (LCL)

ISOTOPIC POWER SUPPLIES

REFER ALSO TO CITATION(S) 38375

DESIGN AND FABRICATION

37777 (COO—4299-025) **Kilowatt Isotope Power System, Phase II plan. Appendix A to Volume II and Volume III: KIPS jet condenser math model.** Niggemann, R.E. (Sundstrand Corp., Rockford, IL (USA). Sundstrand Energy Systems). 15 Mar 1978. Contract AC02-77ET33001. 75p. NTIS, PC A04/MF A01.

The analytical model of the condensation process occurring in a jet condenser that was developed during Phase I of the Kilowatt Isotope Power System Program (KIPS) at Sunstrand Corporation is documented. The analytical model is based on one dimensional gas dynamics in the vapor funnel, a kinetic theory approach to the vapor/liquid interface condensing process and an empirical correlation of the intrajet heat transfer coefficient (from the vapor/liquid interface to the bulk liquid in the jet). This model satisfactorily predicts the measured performance of the KIPS jet condenser. The first section of this KIPS jet condenser report presents the KIPS jet condenser development history from the beginning of the program (August 1975) through February 1977, at which time it was apparent that the initial design was underperforming slightly. It was decided that an improved analytical model would be beneficial. The subsequent sections deal with the development of the basic experimental data taken on a variety of single jets in a steam/water jet condensation rig to obtain the intrajet heat transfer coefficients required by the analytical model. Also included is a section describing the experiments conducted on the jet condenser to determine the limit conditions under which jet condenser floodout can occur.

37778 (COO—4299-025(Vol.1)) **Kilowatt isotope power system. Phase II plan. Volume I. Phase II program plan.** (Sundstrand Corp., Rockford, IL (USA). Sundstrand Energy Systems). 15 Mar 1978. Contract AC02-77ET33001. 54p. NTIS, PC A04/MF A01.

The development of a Kilowatt Isotope Power System (KIPS) was begun in 1975 for the purpose of satisfying the power requirements of satellites in the 1980's. The KIPS is a $^{238}PuO_2$-fueled organic Rankine cycle turbine power system to provide a design output of 500 to 2000 W. Phase II of the overall 3-phase KIPS program is described. This volume presents a program plan for qualifying the organic Rankine power system for flight test in 1982. The program plan calls for the design and fabrication of the proposed flight power system; conducting a development and a qualification program including both environmental and endurance testing, using an electrical and a radioisotope heat source; planning for flight test and spacecraft integration; and continuing ground demonstration system testing to act as a flight system breadboard and to accumulate life data. (LCL)

37779 (COO—4299-025(Vol.4)) **Kilowatt isotope power system, Phase II Plan. Volume IV. Teledyne FSCD vs GDS.** (Teledyne Energy Systems, Timonium, MD (USA)). 15 Mar 1978. Contract AC02-77ET33001. 261p. NTIS, PC A12/MF A01.

This Volume contains Teledyne's input to the Kilowatt Isotope Power System Phase II Plan. Included is a description of the Flight System Heat Generation System, Flight System Radiator, Thermal Insulation Stability, GDS Heat Generation System and GDS Radiator.

37780 (COO—4299-025(Vol.5)) **Kilowatt isotope power system. Phase II plan. Volume V. Safety, quality assurance and reliability.** (Sundstrand Corp., Rockford, IL (USA). Sundstrand Energy Systems). 15 Mar 1978. Contract AC02-77ET33001. 163p. NTIS, PC A08/MF A01.

The development of a Kilowatt Isotope Power System (KIPS) was begun in 1975 for the purpose of satisfying the power requirements of satellites in the 1980's. The KIPS is a $^{238}PuO_2$-fueled organic Rankine cycle turbine power system to provide a design output of 500 to 2000 W. Included in this volume are: launch and flight safety considerations; quality assurance techniques and procedures to be followed through system fabrication, assembly and inspection; and the reliability program made up of reliability prediction analysis, failure mode analysis and criticality analysis. (LCL)

37781 (COO—4299-036) **Quality assurance program plan applicable to the KIPS technology verification phase.** (Sundstrand Corp., Rockford, IL (USA). Sundstrand Energy Systems). 4 Oct 1978. Contract AC02-77ET33001. 34p. NTIS, PC A03/MF A01.

This Quality Program Plan describes the manner in which the Energy Systems Unit of the Advanced Technology Group Division of Sunstrand Corporation applies its Quality Assurance Program and Systems to control and assure commpliance to the Quality requirements in accordance with NRA-1, dated July 1, 1977, in support of the Kilowatt Isotope Power Systems (KIPS) Program Technology Verification Phase.

HYDROGEN

PRODUCTION

REFER ALSO TO CITATION(S) 37771, 38492

ELECTROLYSIS

REFER ALSO TO CITATION(S) 37852, 37855

THERMOCHEMICAL PROCESSES

37782 (GA-A—16019) **Progress report on the development of the General Atomic thermochemical water-splitting process.** Besenbruch, G.E.; Allen, C.L.; Brown, L.C.; McCorkle, K.; Rode, J.S.; Norman, J.H.; Trester, P.; Sharp, R. (General Atomic Co., San Diego, CA (USA)). Aug 1980. Contract AC02-80ET26225. 6p. (CONF-801055—3). NTIS, PC A02/MF A01.

From 5. annual thermal storage meeting; McLean, VA, USA (10 Oct 1980).

The major accomplishments of the DOE funded part of the GA thermochemical water-splitting program are reported. They include: completion of installation of all bench-scale equipment; operation and preliminary data acquisition for bench-scale subunits I and II; design, installation and operation of a system for iodine removal from the low phase; review and modification of Section III of the engineering flowsheet resulting in an increase in process efficiency and decrease in capital cost; and completion of the Funk panel reivew. The results of the experimental work have demonstrated that flowsheet conditions can be achieved in all cases tested. Continued work on the flowsheet has increased our confidence in the economic viability of the sulfur-iodine process.

37783 (ORNL—5665, pp 181-183) **Inorganic chemistry of hydrogen cycles.** Bamberger, C.E.; Robinson, P.R.; Kilyk, J. Jr. Jul 1980.

In Chemistry Division annual progress report, February 29, 1980.

The search for processes that produce hydrogen from water continues because hydrogen is both an attractive source of secondary energy and an important chemical. Among such processes, thermochemical cycles promise to utilize high temperature ($\leqq$ 1500 K) thermal energy with high efficiency. Carbon monoxide can be obtained by splitting CO_2 thermochemically and it can then be used to produce hydrogen and other chemicals. Because the thermodynamic stability of CO_2 is similar to that of water at 700-1100°C, this program was expanded to include a search for CO_2-splitting cycles.

37784 **Oxidation of cerium(III) phosphate in steam in the presence of lithium halides and its use in thermochemical water-splitting cycles.** Bamberger, C.E.; Robinson, P.R. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Inorg. Chem.*; **19**: No. 7, 2181-2183(Jul 1980).

Thermochemical cycles for water splitting employ thermal energy to drive a cyclic series of chemical reactions, the sum of which is just H_2O + thermal energy = H_2 + 1/2 O_2. It was shown previously that cerium (IV) oxide, CeO_2, reacts with alkali metal hydrogen phosphates - MH_2PO_4 or M_2HPO_4, where M = Li, Na, K - at > 600°C to produce O_2(g), cerium(III) phosphate, $CePO_4$, and alkali metal orthophosphates, M_3PO_4. When M = Na or K, the double phosphate $M_3Ce(PO_4)_2$ forms from the $CePO_4$ and the M_3PO_4. In seeking ways to use these reactions in thermochemical cycles, it was discovered that steam will oxidize $CePO_4$ to CeO_2 in the presence of lithium halides - LiX, where X = Cl, Br, I - according to the following reaction: $2CePO_4$(c) + 6LiX(c,l) + $4H_2O$(g) = $2CeO_2$(c) + $2LiPO_4$(c) + 6HX(g) + H_2(g), (c), (l), and (g) refer respectively to the states crystalline, liquid, and gaseous. This paper describes studies of this reaction and its use in thermochemical cycles based on the Ce(IV)/Ce(III) redox couple.

BIOSYNTHESIS AND PHOTOCHEMICAL PROCESSES

37785 (BNL—28334) **Photoproduction of hydrogen by membranes of green photosynthetic bacteria.** Bernstein, J.D.; Olson, J.M. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 6p. (CONF-800963—3). NTIS, PC A02/MF A01.

From 5. international photosynthesis congress; Kassandra-Halkidiki, Greece (7 Sep 1980).

Photoproduction of H_2 from ascorbate by unit-membrane vesicles from Chlorobium limicola f. thiosulfatophilum was achieved with a system containing gramicidin D, tetramethyl-p-phenylenediamine, methyl viologen, dithioerythritol, Clostridium hydrogenase, and an oxygen-scavenging mixture of glucose, glucose oxidase, ethanol, and catalase. Maximum quantum yield was less than one percent. Half maximum rate of H_2 production occurred at a white-light intensity of approximately 0.15 cm^{-2}. The reaction was inhibited completely by 0.3% sodium dodecylbenzene sulfonate, 1% Triton X-100, or preheating the vesicles at 100°C for 5 minutes. Low concentrations (0.01 and 0.05%) of Triton X-100 about doubled the reaction rate.

COAL GASIFICATION

REFER ALSO TO CITATION(S) 37492

STORAGE

37786 (BNL—28293) **Ammonia as a hydrogen energy-storage medium.** Strickland, G. (Brookhaven National Lab., Upton, NY (USA)). Aug 1980. Contract AC02-76CH00016. 8p. (CONF-801055—2). NTIS, PC A02/MF A01.

From 5. annual thermal storage meeting; McLean, VA, USA (10 Oct 1980).

Liquid Hydrogen (LH_2), Methanol (MeOH), and Ammonia (NH_3) are compared as hydrogen energy-storage media on the basis of reforming the MeOH to produce H_2 and dissociating (cracking) the NH_3 to release H_2. The factors important in this storage concept are briefly discussed. Results of the comparison show that, in terms of energy input for media manufacture from natural gas, hydrogen energy content of the medium, and energy cost ($/10^6 Btu), NH_3 has a wide advantage and comes the closest to matching gasoline. The tasks required in developing a safe and practicial hydrogen energy-storage system based on the storage and cracking of NH_3 are listed. Results of the technical and economic evaluation of this concept will provide the basis for continued development.

OTHER SYNTHETIC AND NATURAL FUELS

REFER ALSO TO CITATION(S) 37461

HYDROCARBON FUELS

37787 (PB—80-805245) **Synthetic fuels: methane. Volume 1. 1970-1977 (citations from the Engineering Index data base). Report for 1970-1977.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Feb 1980. 212p. NTIS PC N01/MF N01.

Reports from worldwide research are cited covering the production of methane. The citations pertain to the manufacturing processes and equipment, process performance, economics, and combustion technology. The production of methane from wastes, especially agricultural wastes, are covered extensively. (This updated bibliography contains 205 abstracts, none of which are new entries to the previous edition.)

37788 (PB—80-805252) **Synthetic fuels: methane. Volume 2. 1978-January 1980 (citations from the Engineering Index data base). Report for 1978-Jan 1980.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Feb 1980. 142p. NTIS PC N01/MF N01.

The production of methane is discussed in this bibliography of worldwide journal articles. The reports pertain to the manufacturing processes, equipment used, performance, economics, and combustion technology. Many of the studies cover the production of methane from wastes, especially agricultural wastes. (This updated bibliography contains 135 abstracts, 76 of which are new entries to the previous edition.)

PROPERTIES

REFER ALSO TO CITATION(S) 38508

PREPARATION

CHEMICAL SYNTHESIS

REFER ALSO TO CITATION(S) 37548, 37787, 37788, 38049, 38492

37789 **Methanation of synthesis gas.** Chang, C.D.; Lang, W.H. (to Mobil Oil Corp.). US Patent 4,177,202. 4 Dec 1979. Filed date 26 Jun 1978. 22p.

Light gases rich in methane and ethane are produced from synthesis gas by contacting a CO reducing component of molybdena alone or in combination with an element selected from the group consisting of cobalt and vanadium distributed on a support of alumina or silica/alumina. The presence of hydrogen sulfide in the syngas feed enhances the activity and selectivity for the catalysts to produce ethane rich light gases.

37790 **Catalysts for the conversion of relatively low molecular weight hydrocarbons to high molecular weight hydrocarbons and the regeneration of the catalysts.** Mitchell, H.L. III; Waghorne, R.H. (to Exxon Research and Engineering Co.). US Patent 4,172,810. 30 Oct 1979. Filed date 8 May 1978. 14p.

The primary object of this procedure is to provide novel regenerable catalyst-reagents for an economic low temperature conversion and oligomerization of natural gas to more liquefiable admixtures of higher molecular weight hydrocarbons such as ethylene and benzene. This process will make feasible the collection liquefaction, shipment, and use of much of the excess natural gas which is now flared and wasted at remote sites. The catalyst-reagents include aluminium oxides, magnesium, barium, platinum, iridium, chromium, tungsten, and vanadium. The preparation of these catalysts and their properties are discussed.

PREPARATION FROM WASTES OR BIOMASS

REFER ALSO TO CITATION(S) 37787, 37788, 37797, 37839, 37840, 37848

37791 (CONF-800973—1) **Progress in wood gasification at the University of Missouri-Rolla.** Findley, M.E.; Flanigan, V.J.; Omurtag, Y.; Sineath, H.H. (Missouri Univ., Rolla (USA)). 1980. Contract AC02-79ET23029. 25p. NTIS, PC A02/MF A01.

From 11. biomass thermochemical conversion contractors meeting; Richland, WA, USA (23 Sep 1980).

This report includes the description of the Phase II configuration. The Phase II system provides recycle gas to fluidize the 40 inch reactor and permits the use of catalyst. The design allows the recycle gas to be scrubbed for CO_2 removal if desired. Data from the preliminary testing of the facility is included. Some of the data has been taken from a 6" reactor duplicating the larger system. The smaller reactor is also described. Gas Btu measurements were made with levels of 376 Btu using oxygen in the bed and 369 Btu in recycle alone. The second part of the report describes the work that has been completed on correlating the Phase I (low Btu) data. The principal factors affecting product gas quality and quantity in Phase I are the material balance factors and the quantity of char and tar produced. The char and tar production is related primarily to reactor bed temperature, and can be used with feed rate and air rate to calculate the ratio of total carbon in all gas components to nitrogen. The carbon to nitrogen ratio allows estimation of heating value and total carbon and hydrogen concentrations in the dry gas from correlations. These relationships are adequate to calculate approximate material and energy balances. Maximum capacity is a function of the bed temperature and air to feed ratio, and probably varies from 220 lb/(h ft^2) at around 1000°F to greater than 250 lb/(h ft^2) at 1450°F based on reactor cross sectional area.

37792 (DOE/CS/24310—1) **Full scale field demonstration of unheated anaerobic contact stabilization. Quarterly project status report, April-June 1980.** Sykes, R.M. (Ohio State Univ., Columbus (USA)). Aug 1980. Contract AC02-80CS24310. 11p. NTIS, PC A02/MF A01.

The City of Columbus provided funds for the preliminary shakedown of the anaerobic contact stabilization system. During the shakedown period, the sludge recycle system was tested, and the temperature control system was refurbished. At temperatures as low as 82°F there is no noticeable loss in gas production for SRT's over 14 days. Some of the preliminary data on the overflow and underflow liquors from unit 6E suggested that substantial amounts of VS were not settling in 6E and, consequently, were not being recycled. Therefore, an examination of the settleability of the transfer sludge (4E to 6E) is underway. Some typical preliminary results are shown. The occurence of gasification in the scum layer raises the issue of where the mathanogenic bacteria are to be found in the settler (6E). Some preliminary tests have been conducted to answer this question, and a typical set of results demonstrate the relative population densities of methanogens in scum and settled digested solids. It is clear that if scum is not retained in the system, significant losses of system biomass will occur via the settler overflow.

37793 (DOE/ET/20051—T1) **Anaerobic fermentation of agricultural residue: potential for improvement and implementation. Final report, Volume II.** Jewell, W.J.; Dell'orto, S.; Fanfoni, K.J.; Hayes, T.D.; Leuschner, A.P.; Sherman, D.F. (New York State Coll. of Agriculture and Life Sciences, Ithaca (USA); Cornell Univ., Ithaca, NY (USA)). Apr 1980. Contract AS02-76ET20051. 934p. NTIS, PC A99/MF A01.

Earlier studies have shown that although large quantities of agricultural residues are generated on small farms, it was difficult to economically justify use of conventional anaerobic digestion technology, such as used for sewage sludge digestion. A simple, unmixed, earthen-supported structure appeared to be capable of producing significant quantities of biogas at a cost that would make it competitive with many existing fuels. The goal of this study was to define and demonstrate a methane fermentation technology that

could be practical and economically feasible on small farms. This study provides the first long term, large scale (reactor volumes of 34 m^3) parallel testing of the major theory, design, construction, and operation of a low cost approach to animal manure fermentation as compared to the more costly and complex designs. The main objectives were to define the lower limits for successful fermentor operation in terms of mixing, insulation, temperature, feed rate, and management requirements in a cold climate with both pilot scale and full scale fermentors. Over a period of four years, innovative fermentation processes for animal manures were developed from theoretical concept to successful full scale demonstration. Reactors were sized for 50 to 65 dairy animals, or for the one-family dairy size. The results show that a small farm biogas generation system that should be widely applicable and economically feasible was operated successfully for nearly two years. Although this low cost system outperformed the completely mixed unit throughout the study, perhaps the greatest advantage of this approach is its ease of modification, operation, and maintenance.

37794 (DOE/ET/20062—T1) **Heat treatment of organics for increasing anaerobic biodegradability. Annual progress report, June 1, 1977-May 31, 1978. Civil engineering technical report No. 233.** Healy, J.B. Jr.; Owen, W.F.; Stuckey, D.C.; Young, L.Y.; McCarty, P.L. (Stanford Univ., CA (USA). Dept. of Civil Engineering). 5 Aug 1978. Contract AT03-76ET20062. 58p. NTIS, PC A04/MF A01.

This report contains the results of the last and final 12 months of study under this portion of the grant on the heat treatment of organics to increase biodegradability by methane producing anaerobic bacteria. The purpose of this study has been to develop a means for increasing the yield and reducing the cost of methane gas, which can be used as an energy source. The procedures evaluated were heat treatment at temperatures up to 300°C, generally under alkaline conditions (300 to 400 meq/1 NaOH). Included in this report are results of a study on the effects of alkaline heat treatment on lignocellulosic materials, the bioconversion of nitrogenous organic residues to methane under various chemical heat treatment conditions, and the microbiological examination of the biodegradability of selected lignoaromatic compounds and their conversion to methane. The results obtained on lignin indicate that alkaline treatment at 200°C of the wood sample would yield around 20% conversion of the lignin material. Results obtained on cellulosics indicate about 80% bioconversion of this fraction in the softwood. The data suggest that the effect of heat treatment on WAS is to promote hydrolysis, splitting complex nitrogen polymers into simpler constituent molecules. At temperatures over 175°C, however, decreased bioconversion of both the soluble and insoluble fractions was observed. Results suggest that refractory materials are being formed, accounting partially for the decreased biconversion. In addition, toxic compounds are also being formed, with this effect being more pronounced as treatment conditions become more severe. Data suggest that anaerobic degradation of aromatic ring compounds with the production of methane may be fairly widespread phenomenon among microorganism populations in anaerobic environments.

37795 (DOE/TIC—11261) **Methane and biomass production systems for beef cattle manure.** Hashimoto, A.G.; Prior, R.L.; Chen, Y.R. (Department of Agriculture, Clay Center, NE (USA). Meat Animal Research Center). 1978. 25p. NTIS, PC A02/MF A01.

The research being conducted at the US Meat Animal Research Center to convert livestock manure into methane and a high protein feed ingredient by thermophilic anaerobic fermentation is summarized. The pilot scale fermentor is 5.7 m^3 with working volume between 5.1 to 5.4 m^3. Fermentation was started by adding fresh beef manure to previously heated tap water and maintaining the pH above 7. Gas production increased dramatically within nine days after start up, demonstrating the relative ease in initiating anaerobic fermentation of livestock manures. The results showed that the total solids, volatile solids and COD reduction decreased as the retention time decreased; the fixed solids and total nitrogen were not lost during fermentation; and the total gas and methane production increased as the retention time decreased. Kinetic constants for the generalized substrate utilization model were determined and were in close agreement with previously reported results. Experimental results agreed well with values predicted by the model. High protein biomass from the fermentation is being recovered through centrifugation and by direct incorporation into the ration. Possible disadvantages are high ration moisture content and more feed production than the number of animals needed to produce manure for the fermentation. Amino acid analysis shows that the fermentor effluent compares favorably with soybeans and that the centrifuged cake compares favorably with alfalfa hay. Feeding trials using dried centrifuge cake showed that the digestibility of dry matter, organic matter, and nitrogen tended to decrease slightly as the amount of cake in the ration increased. Preliminary results of the feeding trial using fermentor effluent mixed with corn and hay show that the fermentor effluent is utilized as well as soybean protein.

ALCOHOL FUELS

REFER ALSO TO CITATION(S) 38348

PROPERTIES

REFER ALSO TO CITATION(S) 38349

PREPARATION

CHEMICAL SYNTHESIS

37796 (DOE/CS/50009—1) **Opportunities for coal to methanol conversion.** (American Energy Research Co., McLean, VA). Apr 1980. Contract AC01-79CS50009. 80p. NTIS, PC A05/MF A01.

The accumulations of mining residues in the anthracite coal regions of Pennsylvania offer a unique opportunity to convert the coal content into methanol that could be utilized in that area as an alternative to gasoline or to extend the supplies through blending. Additional demand may develop through the requirements of public utility gas turbines located in that region. The cost to run this refuse through coal preparation plants may result in a clean coal at about $17.00 per ton. After gasification and synthesis in a 5000 ton per day facility, a cost of methanol of approximately $3.84 per million Btu is obtained using utility financing. If the coal is to be brought in by truck or rail from a distance of approximately 60 miles, the cost of methanol would range between $4.64 and $5.50 per million Btu depending upon the mode of transportation. The distribution costs to move the methanol from the synthesis plant to the pump could add, at a minimum, $2.36 per million Btu to the cost. In total, the delivered cost at the pump for methanol produced from coal mining wastes could range between $6.20 and $7.86 per million Btu.

PREPARATION FROM WASTES OR BIOMASS

REFER ALSO TO CITATION(S) 37839, 37844, 37848, 38806

37797 (PNL-SA-—8049) **Methane or methanol via catalytic gasification of biomass.** Mitchell, D.H.; Mudge, L.K.; Robertus, R.J.; Weber, S.L.; Sealock, L.J. Jr. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Mar 1980. Contract AC06-76RL01830. 17p. (CONF-800802—17). NTIS, PC A02/MF A01.

From 89. annual meeting of the American Institute of Chemical Engineers; Portland, OR, USA (17 Aug 1980).

Methane and methanol synthesis gas can be produced by steam gasification of biomass in the presence of appropriate catalysts. A 5 cm diameter reactor has been used to determine the desired catalysts and operating temperature. A process development unit (PDU) has demonstrated steam gasification of biomass with catalysts at rates up to 35 kg per hour. Methane yields of 0.28 nm^3 per kg of dry wood were produced in the small laboratory reactor. Further methanation of the product gas mixture can increase methane yields to 0.33 nm^3/kg. The catalyst system is nickel and silica-alumina. The preferred reactor operating temperature is 500 to 550°C. Tests have been at atmospheric pressure. The PDU performance has confirmed results obtained in the laboratory. Methanol synthesis gas can be produced in a single stage reactor at 750 to 850°C by steam gasification of wood with silica-alumina and nickel catalysts present. From this gas, up to 0.6 kg of methanol can be produced per kg of wood. Gasification of the wood to produce synthesis gas has been demonstrated in the laboratory scale reactor, but remains to be successfully done using the PDU. Catalyst deactivation rates and regeneration schemes must be determined in order to determine the economic feasibility of wood to methane or methanol processes. Some advantages of catalytic steam gasification of biomass over steam-oxygen gasification are: no oxygen is required for methane or methanol synthesis gas, therefore, no oxygen plant is needed; little or no tar is produced resulting in simpler gas cleaning equipment; no shift reactor is required for methanol synthesis; methanation requirements are low resulting in high conversion efficiency; and yields and efficiencies are greater than obtained by conventional gasification.

37798 **Fuels from biomass (fermentation): USA.** Jeffries, T. (Forest Products Lab., Madison, WI); Montenecourt, B.S.; Eveleigh, D.E. pp 226-242 of Fungal biotechnology. Smith, J.E.; Berry, D.R.; Kristiansen, B. (eds.). London, England; Academic Press (1980).

Biotechnology in the United States has advanced broadly in such divergent areas as immobilization of whole cells and enzymes, application of computers to fermenter operation, and bio-separation technology (Wang, Lih and Hatch, 1977). One topic, the production of fuels from biomass, has received considerable emphasis as a result of the dwindling supplies of petroleum and the need to develop alternate renewable energy resources. Biomass such as forest, agricultural and animal residues, can be converted by physiochemical or fermentation processes to clean fuels, petrochemical substitutes or other energy intensive products such as ammonia. This article ad-

dresses the fermentation technologies being developed for these purposes through the Fuels from Biomass Program, US Department of Energy (DOE).

PROPERTIES

REFER ALSO TO CITATION(S) 38507

PREPARATION

REFER ALSO TO CITATION(S) 38827

HYDRO ENERGY

HYDRO ENERGY

REFER ALSO TO CITATION(S) 38242

RESOURCES AND AVAILABILITY

REFER ALSO TO CITATION(S) 37810

37799 (FERC—0045/3) **Planning status report: water resources appraisal for hydroelectric licensing, Kennebec River basin, Maine.** (Federal Energy Regulatory Commission, New York (USA). New York Regional Office). 1980. 16p. NTIS, PC A02/MF A01.

The physical characteristics, hydrology, climate, population, and economy of the Kennebec River basin in west central Maine are described. Existing water resource developments are tabulated and discussed. The licensing status of 17 existing hydro plants is reviewed. Twenty potential hydroelectric projects which are being considered and their plans for each are summarized. (LCL)

37800 (FERC—0047) **Planning status report: water resources appraisal for hydroelectric licensing, Potomac River basin, Pennsylvania, Maryland, West Virginia, Virginia, and District of Columbia.** (Federal Energy Regulatory Commission, Washington, DC (USA). Office of Electric Power Regulation). 1980. 16 p. NTIS, PC A02/MF A01.

Updated information on water resources in the Potomac River Basin is presented for use by the FERC and its staff when considering hydroelectric licensing and other work. The report presents data on water resource developments, existing and potential, and on water use by existing and projected steam-electric generating facilities. Past and present planning studies are summarized.

37801 (FERC—0048) **Planning status report: water resources appraisal for hydroelectric licensing, Menominee River basin, Michigan, Wisconsin.** (Federal Energy Regulatory Commission, Chicago, IL (USA). Chicago Regional Office). Aug 1980. 15p. NTIS, PC A02/MF A01.

The Menominee River basin located in northernmost Wisconsin and the central section of the Upper Peninsula of Michigan is described. Tabulated data are presented on existing and retired hydro power plants and on thermal power plants in the basin and on the licensing status of existing hydro plants. Potential water resource developments and the need for additional studies are discussed. (LCL)

37802 (FERC—0056) **Planning status report: water resources appraisal for hydroelectric licensing, Penobscot River basin, Maine.** (Federal Energy Regulatory Commission, New York (USA). New York Regional Office). Aug 1980. 15p. NTIS, PC A02/MF A01.

The physical, demographic, and economic characteristics of the Penobscot River basin in central Maine are described. Data are presented on existing and potential water resource developments and on water use by the single thermal power plant in the basin. The statistics on potential and retired hydro power projects in the basin are tabulated. (LCL)

37803 (FERC—0057) **Appraisal report: water resources appraisal for hydroelectric licensing, Skagit River basin, Washington.** (Federal Energy Regulatory Commission, San Francisco, CA (USA). San Francisco Regional Office). Aug 1980. 82p. NTIS, PC A05/MF A01.

This report on the Skagit River basin, Washington was prepared primarily to provide information which the Federal Energy Regulatory Commission (FERC) may use when considering matters related to hydroelectric licensing, relicensing, or recommendations for Federal takeover. Information is included on the hydrology, geology, and climate of the basin; demographic and economic characteristics; existing water and land resource development; and needs for further resource development. It is concluded that the resource developments being considered, i.e., raising Ross Dam by 121 ft, the Copper Creek Project, and diversion of Thunder Creek, are all economically justified and desirable. Pumped storage developments in the Northwest are judged to be impractical in the foreseeable future. (LCL)

37804 (FERC—0059) **Planning status report: water resources appraisal for hydroelectric licensing, Brazos River basin, Texas, New Mexico.** (Federal Energy Regulatory Commission, Fort Worth, TX (USA). Fort Worth Regional Office). 1980. 15p. NTIS, PC A02/MF A01.

The physical, demographic and economic characteristics of the Brazos River basin which extend from southeastern New Mexico to the Gulf of Mexico near Houston, Texas are described. Data on existing and potential water resource developments, the status of hydro power plant licensing, and water requirements for existing and planned thermal power plants in the basin are tabulated and discussed. (LCL)

37805 (FERC—0060) **Planning status report: water resources appraisals for hydroelectric licensing, Upper Arkansas River basin, Colorado, Kansas, and New Mexico.** (Federal Energy Regulatory Commission, Washington, DC (USA). Office of Electric Power Regulation). 1980. 21p. NTIS, PC A02/MF A01.

The physical, demographic and economic characteristics of the Upper Arkansas River basin located in southeastern Colorado, western Kansas and the extreme north part of New Mexico are described. Data are presented on existing and potential water resource developments, the status of hydro power plant licensing, resources planning and the water requirements for thermal power plants to be installed by the year 2000. (LCL)

37806 (FERC—0061) **Planning status report: water resources appraisals for hydroelectric licensing, Saginaw and Au Sable River basins area, Michigan.** (Federal Energy Regulatory Commission, Washington, DC (USA). Office of Electric Power Regulation). 1980. 13p. NTIS, PC A02/MF A01.

The physical, demographic and economic characteristics of the Saginaw and Au Sable River Basins area along the west shore of Lake Huron in Michigan are described. Data on existing and potential water resource developments and on water use by existing and planned thermal power plants in the basin are presented. Past and current planning studies are summarized. (LCL)

PLANT DESIGN AND OPERATION

REFER ALSO TO CITATION(S) 38203

37807 (DOE/RA/01693—T1) **Schneider lift translator system low head hydro feasibility study. Final report.** Schneider, D.J.; Schwartz, P.; Danstrom, E.K.; Miller, E.M.; Choe, M.G.; Miller, J.W.; Kim, G.O. (Schneider Lift Translator Co., Irving, TX (USA)). 9 Mar 1979. Contract AC07-78RA01693. 386p. NTIS, PC A17/MF A01.

A contract exists between Turlock Irrigation District (TID), Ergotex Corporation (ET), and Schneider Lift Translator Co. (SLT) to commence commercial installation of Schneider Hydrodynamic Power Generator (SHPG) power plants in the TID main canal provided that projected installed capital cost is under $700/KW with power generated at a unit cost of under 2.0 centsKWH based upon 10 to 15 MW of installed capacity. The SHPG uses a translational lift concept to develop power in low head, intermediate and low velocity flow circumstances. Simplicity of the SHPG lift translator design together with an operation free of troublesome stresses induced by centrifugal forces, results in ease of hydrofoil manufacture with low initial, as well as operating and maintenance costs, even at extremely high discharge rates. The US is estimated to have a low-head hydro resource in excess of 300 million KW. No new technology breakthrough is needed for near term production from these hydropower resources using the SHPG. The program objectives were to establish the basic design criteria; to identify probable costs; and to predict prototype performance.The program objectives were fulfilled. The results show the hydraulic efficiency to exceed 80%, a prototype capital cost covering the completed facility of $693/KW and a 30-year levelized energy cost per KWH of 2.16 cents for installation at TID Drop 6 with the initial energy cost being well under 2.0 cents. Estimates of the delivered cost of the Schneider Engine with speed increaser, generator, switchgear and transformer showed that for a four-fold increase in head (7.25 to 28 ft), the cost per KW output is reduced 65% ($359 to $127/KW), considerably lower than the delivered cost of turbines.

REGULATIONS AND LICENSING

REFER ALSO TO CITATION(S) 37799, 37801, 37802, 37803, 37804, 37805, 37806

37808 (DOE/RA/04934—15) **Legal obstacles and incentives to the development of small-scale hydroelectric power in Virginia.** (Energy Law Inst., Concord, NH (USA). Franklin Pierce Law Center). May 1980. Contract AS02-78RA04934. 52p. NTIS, PC A04/MF A01.

The legal and institutional obstacles to the development of small-scale hydroelectric energy in Virginia are described. The state regulatory system does not comprise final authority; the Federal government also exercises extensive regulatory authority in the area. This dual system is a function of the federalist nature of our government. The introductory section examines the dual system from the standpoint of the appropriate legal doctrine, the law of preemption, application of the law to the case of hydroelectric development, and inquires into the practical use of the doctrine by the FERC. The use of a natural-surface watercourse in Virginia is governed generally by the doctrine of riparian rights. Riparian rights is a system of water rights based on ownership of land bordering on a natural stream or watercourse. For land to be considered riparian to a stream, that land must be located on the watershed of that portion of the stream. The theory of riparian rights followed in Virginia is one of reasonable use. Under the reasonable-use doctrine, each riparian owner has an equal right to the reasonable use of the water running naturally through or by his land for any useful purpose. The water must continue to run after such use without material diminution or alteration and without pollution.

37809 (DOE/RA/23220—02) **Case studies of the legal and institutional obstacles and incentives to the development of small-scale hydroelectric power: Bull Run, Portland, Oregon.** (Energy Law Inst., Concord, NH (USA). Franklin Pierce Law Center). May 1980. Contract FG03-78RA23220. 98p. NTIS, PC A05/MF A01.

The National Conference of State Legislatures' Small-Scale Hydroelectric Policy Project is designed to assist selected state legislatures in looking at the benefits that a state can derive from the development of small-scale hydro, and in carrying out a review of state laws and regulations that affect the development of the state's small-scale hydro resources. The successful completion of the project should help establish state statutes and regulations that are consistent with the efficient development of small-scale hydro. As part of the project's work with state legislatures, seven case studies of small-scale hydro sites were conducted to provide a general analysis and overview of the significant problems and opportunities for the development of this energy resource. The case study approach was selected to expose the actual difficulties and advantages involved in developing a specific site. Such an examination of real development efforts will clearly reveal the important aspects about small-scale hydro development which could be improved by statutory or regulatory revision. Moreover, the case study format enables the formulation of generalized opportunities for promoting small-scale hydro based on specific development experiences. The case study for small-scale hydro power development at the City of Portland's water reserve in the Bull Run Forest is presented with information included on the Bull Run hydro power potential, current water usage, hydro power regulations and plant licensing, technical and economic aspects of Bull Run project, and the environmental impact. (LCL)

ECONOMICS AND MANAGEMENT

37810 (EGG-HYD—5247) **Hydropower computerized reconnaissance package.** Broadus, C.R. (EG and G Idaho, Inc., Idaho Falls (USA)). Sep 1980. Contract AC07-76ID01570. 72p. NTIS, PC A04/MF A01.

The Hydropower Computerized Reconnaissance (HCR) Package is a computerized preliminary economic study package for small hydroelectric projects. The HCR package was developed by EG and G Idaho, Inc. at the Idaho National Engineering Laboratory. It is designed to perform two levels of studies depending upon the amount of site-specific information available, and an Apple II computer is utilized to provide a quick-turnaround capability. The models and methods used in the HCR package are described. It provides information on program application, sample run sessions, program outputs, and listings of the main programs.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 37809

37811 (ORNL/TM—7453) **Analysis of environmental issues related to small-scale hydroelectric development. III. Water level fluctuation.** Hildebrand, S.G. (ed.). (Oak Ridge National Lab., TN (USA)). Oct 1980. Contract W-7405-ENG-26. 130p. NTIS, PC A07/MF A01.

Potential environmental impacts in reservoirs and downstream river reaches below dams that may be caused by the water level fluctuation resulting from development and operation of small scale (under 25MW) hydroelectric projects are identified. The impacts discussed will be of potential concern at only those small-scale hydroelectric projects that are operated in a store and release (peaking) mode. Potential impacts on physical and chemical characteristics in reservoirs resulting from water level fluctuation include resuspension and redistribution of bank and bed sediment; leaching of soluble organic matter from sediment in the littoral zone; and changes in water quality resulting from changes in sediment and nutrient trap efficiency. Potential impacts on reservoir biota as a result of water level fluctuation include habitat destruction and the resulting partial or total loss of aquatic species; changes in habitat quality, which result in reduced standing crop and production of aquatic biota; and possible shifts in species diversity. The potential physical effects of water level fluctuation on downstream systems below dams are streambed and bank erosion and water quality problems related to resuspension and redistribution of these materials. Potential biological impacts of water level fluctuation on downstream systems below dams result from changes in current velocity, habitat reduction, and alteration in food supply. These alterations, either singly or in combination, can adversely affect aquatic populations below dams. The nature and potential significance of adverse impacts resulting from water level fluctuation are discussed. Recommendations for site-specific evaluation of water level fluctuation at small-scale hydroelectric projects are presented.

SOLAR ENERGY

RESOURCES AND AVAILABILITY

REFER ALSO TO CITATION(S) 38046

37812 (DOE/ET/20172—2) **Solar Energy Meteorological Research and Training Site: Region 5. Annual report, 1 October 1978-30 September 1979.** Rao, C.R.N.; Hewson, E.W. (Oregon State Univ., Corvallis (USA). Dept. of Atmospheric Science). Mar 1980. Contract FG06-77ET20172. 32p. NTIS, PC A03/MF A01.

The field observing facility of the primary research centre located at Oregon State University, Corvallis, is now fully operational, and research quality solar radiation and allied meteorological data have been routinely acquired since February 1979. The five-site, statewide network of solar monitoring stations located at Bend, Coos Bay, Eugene, La Grande, and Whitehorse Ranch has continued to function smoothly. A study of the response characteristics of radiation sensors, mainly of the thermopile type, has been completed. Also, the dependence of the accuracy of the computed values of irradiation on the sampling rate has been examined. Two solar energy related courses - one at the senior level and the other at the advanced graduate level - were taught. Seminars on different topics in the broad discipline of solar radiation meteorology, were arranged.

37813 (SAND—80-1637) **Sum-of-Gaussians representation of sunshape.** Vittitoe, C.N.; Biggs, F. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1980. Contract AC04-76DP00789. 46p. NTIS, PC A03/MF A01.

The angular distribution of sunlight reaching the earth varies considerably because of interaction with the atmosphere. Five typical sunshapes, chosen from the widest to the narrowest shape in the Lawrence Berkeley Laboratory data, are approximated by a sum of six Gaussian distributions. In many applications sunshapes are convolved with error-cone distributions that represent a statistical description of uncertainties encountered in an optical concentrating system. Sunshape convolution with a series of circular-normal error cones indicates that the effective sunshape is well represented by analytic convolution between the error cone and the sum of Gaussians. This analytic convolution can replace the more costly (in time and computer storage) numerical methods for convolving the error cone and the experimental sunshape distribution. Results of both calculation methods are found to be consistent when the dispersion of the error cone is greater than 0.0012. A simple prescription indicates how each of the analytic representations may be transformed to approximate sunshapes appropriate for slightly different atmospheric conditions. The analytic form of the effective sunshape is given as a sum of six elliptic-normal distributions when the error cone is an elliptic-normal distribution.

ECONOMICS

REFER ALSO TO CITATION(S) 37870 38253

37814 (DOE/EV—0099) **Summary of solar energy technology characterizations.** (Mitre Corp., McLean, VA (USA); Argonne National Lab., IL (USA); Oak Ridge National Lab., TN (USA); Los Alamos Scientific Lab., NM (USA); California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1980. Contract W-31-109-ENG-38. 190p. NTIS, PC A09/MF A01.

This report summarizes the design, operating, energy, environmental, and economic characteristics of 38 model solar systems used in the Technology Assessment of Solar Energy Systems Project including solar heating and cooling of buildings, agricultural and industrial process heat, solar electric conversion, and industrial biomass systems. The generic systems designs utilized in this report were based on systems studies and mission analyses performed by the DOE National Laboratories and the MITRE Corporation. The purpose of those studies were to formulate materials and engineering cost data and performance data of solar equipment once mass produced.

ENVIRONMENTAL, LEGAL, AND INSTITUTIONAL ASPECTS

REFER ALSO TO CITATION(S) 37872, 37881, 38218, 38309, 38644, 38906, 38907, 38908

37815 (CONF-800491—, pp 439) **Atmospheric effects overview.** Rote, D.M. (Argonne National Lab., IL). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

SOLAR ENERGY CONVERSION

PHOTOVOLTAIC CONVERSION

REFER ALSO TO CITATION(S) 37872, 38477

37816 (DOE/ET/23008—T2) **Emerging materials for solar cell applications: electrodeposited CdTe. Third quarter report, September 1-November 30, 1979.** Rod, R.L.; Shkedi, Z.; Bunshah, R.; Stafsudd, O. (Monosolar, Inc., Santa Monica, CA (USA)). 20 Dec 1979. Contract AC04-79ET23008. 27p. NTIS, PC A03/MF A01.

Major emphasis during the period was centered on improving the material properties of electrodeposited CdTe. Using newly devised means for peeling thin CdTe films off the ITO-coated glass substrates, it was possible to accurately measure material density and electrical resistivity. Density proved to be 40% below the bulk CdTe figure of about 6 gm/cm^3, while resistivity of supposedly doped CdTe films exceeded $10^8\Omega$ - cm. These findings prompted initiation of a beneficial change in plating procedures which increased the thin film polycrystalline CdTe density to the bulk value while, at the same time, good columnar growth was obtained. Films made under the old plating process were made into Schottky diodes showing good uniformity and V/sub oc/ values generally exceeding 0.5V. Short circuit current of the best of these was 9.5mA/cm^2 despite the fact that light entered through a thick gold film and was strongly attenuated.

37817 (DOE/ET/23011—1) **Boron arsenide thin film solar cell development. Final report.** Boone, J.L.; Van Doren, T.P. (Eagle-Picher Industries, Inc., Miami, OK (USA). Miami Research Labs.). Sep 1980. Contract AC02-79ET23011. 137p. NTIS, PC A07/MF A01.

Pyrolytic decomposition of diborane and arsine has been used in attempts to grow polycrystalline BAs films. This method, however, produced only amorphous films for deposition temperatures below 920°C and polycrystalline boron subarsenide ($B_{12}As_2$) flms for deposition temperatures above this value. The amorphous films have been determined to have a significant arsenic content but the actual stoichiometry was not obtained. The films were adherent on single crystal sapphire (0001), (111) silicon, (0001) SiC, and polycrystalline SiC but were found not to be adherent to substrates of fused quartz, tungsten, and molybdenum. It was also found that all films deposited above 650°C were p-type while those deposited below 600°C were usually n-type. Polycrystalline BAs and $B_{12}As_2$ was produced by reaction of the elements in a closed tube. The amorphous films showed an indirect or non-direct optical bandgap from 1.0 to 1.7 eV with the most probable values between 1.2 to 1.4 eV. The crystalline BAs powder shows a bandgap near 1.0 eV. Photoconductance time constants have been measured for films deposited on (0001) sapphire and (0001) SiC. Attempts at doping the amorphous films were generally unsuccessful. A polycrystalline powder sample was successfully doped with sulfur. Attempts were made to produce a Schottky barrier diode by evaporating Al dots onto an amorphous film on graphite without a post-evaporation anneal. An MIS structure was also attempted by baking an amorphous film in air at 280°C before evaporation of aluminum. Although nonlinear characteristics were obtained, none of the devices showed any photovoltaic response. A p-type amorphous film was deposited on an n-type silicon substrate to form a p-n heterojunction. This device did exhibit a photovoltaic response but it is believed that the photogeneration was occurring primarily in the silicon substrate.

37818 (DOE/ET/23046—3) **Electrodeposition of polycrystalline and amorphous silicon for photovoltaic applications. Quarterly technical progress report No. 03, December 1, 1979-February 29, 1980.** Rauh, R.D.; Rose, T.L.; Boudreau, R.A.; Hoover, T.O.; Natwig, D.L. (EIC Corp., Newton, MA (USA)). Jul 1980. Contract AC03-79ET23046. 36p. NTIS, PC A03/MF A01.

The survey of Si precursors leading to electrodeposition of Si in organic solvents was extended this quarter to cover $SiCl_4$, $(ClC_3H_6)SiCl_3$, and $Si(OEt)_4$. Plating experiments with $SiHCL_3$ solutions in propylene carbonate with 0.1M tetrabutylammonium tetrafluoroborate were continued. Silicon was deposited on ITO glass (Nesatron) as well as Mo substrates at temperatures from 25-80°C. Both potentiostatic and galvanostatic conditions were used. The high resistance of the films (10^6-10^8 Ω-cm) limited the thickness which could be deposited by either method to less than 5 μm. X-ray analysis of the films confirmed that they were amorphous. SEM analysis of the films revealed a very porous structure with nodules about 1 μm in diameter. Annealing the deposit at 400°C in an Ar:H_2 atmosphere resulted in a slightly smoother surface but the nodules remained. The films deposited on ITO glass had a band gap of about 1.0 eV and an EO_4 value of 1.5-2.0 eV. The Auger analysis of the films showed the presence of large amounts of oxygen in the samples that had been exposed to air. The first silicon deposits were obtained from the high temperature fluoride molten salts. Plating on a platinum cathode resulted in silicide formation which suggests a method of making a PtSi alloy for use as a stable reference electrode in the fluoride melts containing silicon (IV). Galvanostatic deposition on silver substrates in general gave thick, uneven, and poorly adherent deposits.

37819 (DOE/JPL/955244—80/5) **Development of low cost contacts to silicon solar cells. Final report, 15 October 1978-30 April 1980.** Tanner, D.P.; Iles, P.A. (Optical Coating Lab., Inc., City of Industry, CA (USA). Photoelectronics Div.). 1980. Contract NAS-7-100-955244. 140p. NTIS, PC A07/MF A01.

A summary of work done on the development of a copper based contact system for silicon solar cells is presented. The work has proceeded in three phases: (1) Development of a copper based contact system using plated Pd-Cr-Cu. Good cells were made but cells degraded under low temperature (300°C) heat treatments. (2) The degradation in Phase I was identified as copper migration into the cells junction region. A paper study was conducted to find a proper barrier to the copper migration problem. Nickel was identified as the best candidate barrier and this was verified in a heat treatment study using evaporated metal layers. (3) An electroless nickel solution was substituted for the electroless chrominum solution in the original process. Efforts were made to replace the palladium bath with an appropriate nickel layer, but these were unsuccessful. 150 cells using the Pd-Ni-Cu contact system were delivered to JPL. Also a cost study was made on the plating process to assess the chance of reaching 5 cents/watt.

37820 (DOE/JPL/955269—80/4) **Low Cost Solar Array Project: Task I, silicon material. Gaseous melt replenishment system, annual report, April 1979-April 1980.** Jewett, D.N.; Bates, H.E.; Hill, D.M. (Energy Materials Corp., Harvard, MA (USA)). 1980. Contract NAS-7-100-955269. 37p. NTIS, PC A03/MF A01.

This 18 month contract is intended to research and develop an innovative method of low cost silicon production from known technology, deposition of silicon from a hydrogen-chlorosilane mixture. The contract is divided into four major Tasks and a subcontract for evaluation of silicon produced. The goal of Task I is to produce 1/2 kg/h silicon for 24 hours with at least 18% conversion of trichlorosilane to silicon. The Task II goal is to improve the reactor to produce 1/2 kg/h at a minimum conversion of 18% for 96 hours. The goal of Task III is to deliver liquid silicon from the reactor through a tube to a Czochralski crystal puller. Task IV is to operate the production system simultaneously with the Czochralski unit continuously for one week. Silicon produced will be evaluated by solar cell fabrication by Applied Solar Energy Corporation. Progress is reported.

37821 (DOE/JPL/955491—80/3) **Development of processes for the production of solar grade silicon from halides and alkali metals. Third quarterly report, April 1-June 30, 1980.** Gould, R.K. (Aerochem Research Labs., Inc., Princeton, NJ (USA)). Sep 1980. Con-

tract NAS-7-100-955491. 11p. (AeroChem-TN—215). NTIS, PC A02/MF A01.

This program is directed toward the development of processes involving high temperature reactions of silicon halides with alkali metals for the production of solar grade silicon in volume at low cost. Experiments are performed to evaluate product separation and collection processes, measure heat release parameters for scaling purposes, determine the effects of reactants and/or products on materials of reactor construction, and make preliminary engineering and economic analyses of a scaled-up process. During this report period work concentrated on preparing samples of silicon for purity analyses. The results of six such analyses are given. In general, they indicate that the process is capable of producing very pure silicon. A number of impurity elements appear in 0.1 to 10 ppMa concentrations in one or another of the samples in unpredictable patterns. This would be expected for the one hour runs performed since atmospheric dust has easy access to collection surfaces during assembly and laboratory conditions do not allow clean assembly procedures to be followed. Particularly encouraging is the observation that sodium levels are below 10 ppMa in most runs.

37822 (PB—80-127343) **Silicon schottky photovoltaic diodes for solar energy conversion. Quarterly progress report 1 Apr-30 Jun 77.** Anderson, W.A. (Rutgers--the State Univ., New Brunswick, NJ (USA). Dept. of Electrical Engineering). Jul 1977. 28p. NTIS, PC A03/MF A01.

Research involved in increasing the efficiency of the Schottky solar cell is presented. Fabrication studies employed different Schottky metals and new antireflection (A/R) coatings to improve circuit current density (J(sc)). Results previously obtained with several Schottky metals are compared to recent data on titanium. The higher J(sc) of titanium is due to its better optical transmission characteristics but is insufficient to offset lowered open circuit voltage. Ellipsometry and Auger studies were conducted to more fully characterize the thin oxide layer between Schottky metal and silicon. New cerium and antimony oxide A/R coatings produced 5-10 percent improvement in J(sc). The refractive index of these coatings was obtained by measuring oscillations in transmission on glass slides. Solar cell analysis was extended to include ellipsometry studies of thin oxide films on silicon which determine the oxide thickness. Surface state and lock-in-amplifier measurements were performed to establish surface state distribution in the energy gap. Environmental studies show that the polystyrene encapsulant offers better degradation protection than the Sylgard 184 for Schottky cells.

37823 (SAND—80-1737) **Single cell high concentration solar test facility.** Hammons, B.E. . (Sandia National Labs., Albuquerque, NM (USA)). Sep 1980. Contract AC04-76DP00789. 36p. NTIS, PC A03/MF A01.

A test facility is now in operation which measures performance data for photovoltaic cells over a wide range of concentration ratios (1 to 1500x) and temperatures (ambient to over 100°C). The facility presently uses a 71 cm diameter Fresnel lens as the concentrator. The lens and solar cell (with appropriate cooling fixtures) are mounted on a 2-axis tracking pedestal which is positioned by a sun-seeking tracking device. The intensity of the incoming solar insolation is measured by a normal incidence pyrheliometer attached to this same tracking pedestal. Cell cooling is accomplished by the liquid impingement technique, and temperatures are held constant by a variable flow rate cooling loop using a 50/50 mixture of glycol/water as the coolant. Safety interlocks prevent the operator from being exposed to the high intensity solar radiation. Data acquisition and the associated instrumentation are controlled by a desk top computer. The computer also provides the user with a variety of cell parameters and methods of viewing the test results.

37824 (SAND—80-7071) **Near-term implementation of production cost reductions for photovoltaic concentrator arrays.** Lawrence, I. (Spectrolab, Inc., Sylmar, CA (USA)). Aug 1980. Contract AC04-76DP00789. 39p. NTIS, PC A03/MF A01.

The major goal of this program is the achievement of near term photovoltaic concentrator cost reduction by implementing a unique process sequence for the fabrication of concentrator solar cells from raw silicon wafers. The innovation utilized in this process sequence consists of fabricating thick film conductive ink front contacts by utilizing solid photoresist as a mask. This approach overcomes the relatively poor line width resolution (approximately 5 mils) characteristic of conventional screen printing technology, while retaining the cost advantages of this technique. In this way, the premium performance characteristics of evaporated metal front contacts are combined with the low cost and high production capabilities of thick film materials and techniques. The process sequence is described in detail. Cells with adherent thick film conductive ink front contacts were fabricated on a consistent basis, on cells laminated with one, two, and three layers of RISTON type 1210 photoresist. Low short circuit current and high series resistance precluded these cells from being suitable for concentrator applications. In an effort to alleviate these problems, several alternative processing techniques were evaluated. Despite the fact that each of these techniques was very successful in combatting a specific problem area, additional process development work is necessary in order to incorporate these modifications into the baseline processing sequence. (WHK)

37825 (SERI/PR—8058-2-T1) **Advanced photovoltaic concentrator cells. Quarterly technical progress report No. 3, March 1-May 31, 1980.** Yang, H.T.; Yang, J.J.J.; Zehr, S.W. (Rockwell International Corp., Anaheim, CA (USA)). Jun 1980. Contract AC02-77CH00178. 37p. NTIS, PC A03/MF A01.

Activities on a project aimed at demonstrating the technical feasibility of advanced high efficiency concentrator solar converters are reported. The goal of the program is to achieve 30% conversion efficiency with a converter operating at 30°C under 500-1000 SUNs AM2 illumination and 25% conversion efficiency with a converter operating at 150°C under 500-1000 SUNs AM2 illumination. The approach is to fabricate two cell, non-lattice matched, monolithic stacked converters using optimum pairs of cells having bandgaps in the range of 1.6 to 1.7 eV and 0.95 to 1.1 eV. The high bandgap subcells are to be fabricated using MO-CVD or LPE to produce the needed AlGaAs layers of optimized composition, thickness and doping to produce high performance, heteroface homojunction devices. The low bandgap subcells are to be similarly fabricated from AlGaSb(As) compositions by LPE. These subcells are then to be joined into a monolithic structure by an appropriate thermal bonding technique which will also form the needed transparent intercell ohmic contact (IOC) between the two subcells. The low bandgap subcell development activities have continued during this quarter. In addition, a problem of poor blue response observed for AlGaAs high bandgap cells grown by MO-CVD has been addressed and solved. The Nd-glass pulsed laser for bonding has been received and is being made operational.

37826 (SERI/PR—8081-1-T2) **Materials for high efficiency monolithic multigap concentrator solar cells. SERI quarterly report No. 5, 1 April-30 June 1980.** (Varian Associates, Inc., Palo Alto, CA (USA)). 1980. Contract AC02-77CH00178. 21p. NTIS, PC A02/MF A01.

The objectives of this work are to develop a materials technology of the AlGaInAs and AlInAsSb mixed crystal systems. These technologies are directed towards the development of a two-gap, monolithic, lattice-matched concentrator cell with 28% or higher AM2 conversion efficiency at 500 to 1000 suns. The work to be performed is subdivided into five major tasks: (1) develop and demonstrate the technology for a grading layer of GaInAs/GaAs and low-bandgap cells in AlGaInAs/GaInAs/GaAs; (2) develop and demonstrate inter-cell tunnel junction contacts in the higher bandgap AlGaInAs alloys; (3) develop and demonstrate technology for a higher bandgap concentrator cell in AlGaInAs alloys; (4) demonstrate a complete two-gap monolithic concentrator cell with AM2 efficiency of 28% or more; and (5) investigate the potential of AlInAsSb alloys grown on InAs substrates. Progress is reported. (WHK)

37827 (SERI/PR—9077-1-T1) **Thin film polycrystalline silicon solar cells.** Ghosh, A.K.; Feng T.; Eustace, D.J.; Maruska, H.P. (Exxon Research and Engineering Co., Linden, NJ (USA). Advanced Energy Systems Labs.). 1980. Contract AC02-77CH00178. 33p. NTIS, PC A03/MF A01.

During the present quarter efficiency of heterostructure solar cells has been increased from 13 to 13.7% for single crystal and from 10.3 to 11.2% for polysilicon. For polysilicon the improvements can be attributed to reductions in grid-area coverage and in reflection losses and for single crystal to a combination of reduction in grid-area coverage and increase in fill factor. The heterostructure cells in both cases were ITO/n-Si solar cells. Degradation in SnO_2/n-Si solar cells can be greatly reduced to negligible proportions by proper encapsulation. The cells used in stability tests have an average initial efficiency of 11% which reduces to a value of about 10.5% after 6 months of exposure to sunlight and ambient conditions. This small degradation occurs within the first month, and the efficiency remains constant subsequently. The reduction in efficiency is due to a decrease in the open-circuit voltage only, while the short-circuit current and fill factor remain constant. The effects of grain-size on the Hall measurements in polysilicon have been analyzed and interpreted, with some modifications, using a model proposed by Bube. This modified model predicts that the measured effective Hall voltage is composed of components originating from the bulk and space-charge region. For materials with large grains, the carrier concentration is independent of the inter-grain boundary barrier, whereas the mobility is dependent on it. However, for small rains, both the carrier density and mobility depend on the barrier. These predictions are consistant with experimental results of mm-size Wacker polysilicon and μm-size NTD polysilicon.

37828 (SERI/PR—9079-1-T2) **Structural and electronic studies of defects in amorphous silicon.** Street, R.A. (Xerox Palo Alto

Research Center, CA (USA)). Jun-Aug 1980. Contract AC02-77CH00178. 34p. NTIS, PC A02/MF A01.

A series of experiments which study in detail the structure and properties of α-Si:H films grown with a columnar morphology are described. Studies on the effects of inert gas dilution of silane on plasma deposited α-Si:H films, oxidation and interface states in α-Si:H, and compositional anisotropy and microstructure of α-Si:H are presented. (WHK)

37829 (SER1/PR—9131-1-T1) **Controlled cadmium telluride thin films for solar cells applications. First quarterly report, June 1, 1980-September 1, 1980.** Das, M.B.; Krishnaswamy, S.V. (Pennsylvania State Univ., University Park (USA). Materials Research Labs.). Sep 1980. Contract AC02-77CH00178. 14p. NTIS, PC A02/MF A01.

During the first quarter of this renewed program, efforts have been extended mainly to set up a new ion beam sputtering system that would replace our existing r.f. sputtering system for the fabrication of doped CdTe thin films for solar cell applications. Preliminary attempts with this new equipment resulted in films with rather large grain size (0.8μ - 1μm) at an elevated substrate temperature. While this in itself is encouraging, certain difficulties were confronted in achieving the total control of the system which prevented the deposition of films with satisfactory quality. While attention is being given to bring the system under control, frequency dependent capacitance and conductance measurements were conducted on Schottky barrier diodes prepared from earlier deposited films. The results indicate presence of possible deep levels with distributed energy that might have limited the photovoltaic performance of these samples by reducing carrier lifetime. This appears to justify the decision to change the old r.f. sputtering system in favor of an ion beam sputtering system for this investigation.

37830 (UCID—18041-80(Pts.3-4)) **Systematic computation of the performance of photovoltaic cells based on first principles.** Yee, J.H.; Burke, G.J.; Harvey, R.G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Sep 1980. Contract W-7405-ENG-48. 71p. NTIS, PC A04/MF A01.

The optical and transport properties derived from theory are presented for BAs, $CdSiAs_2$, and $ZnSiAs_2$. The physical specific parameters calculated are: the optical absorption coefficient, the carrier mobilities, the effective masses, and the diffusion length of the electrons and the holes. Also, optical transition matrix elements between different conduction and valence bands of the $ZnSiAs_2$ and $CdSiAs_2$ compounds are theoretically analyzed. The theoretical results are in agreement with the experimental findings that $CdSiAs_2$ has a direct band-gap and $ZnSiAs_2$ has a pseudodirect-gap. In the case of BAs, it has been established that the band-gap is indirect, in contrast to the existing experimental conclusion that the band-gap of the BAs is direct. Comparison between the diffusion lengths of these compounds with those of GaAs and Si are discussed. Based upon our calculation, the optical properties of the Si are far superior than that of BAs, and the optical and the transport properties of $CdSiAs_2$ are better than that of $ZnSiAs_2$. In terms of both of the optical and transport properties, $CdSiAs_2$ is similar to that of GaAs.

37831 Scanned laser response studies of metal-insulator-silicon solar cells in polycrystalline czochralski silicon. Szedon, J.R.; Temofonte, T.A.; O'Keeffe, T.W. (Westinghouse Research and Development Center, Pittsburgh, PA). Contract AC03-76ET20408. *Sol. Cells;* **1**: No. 3, 251-259(May 1980).

Metal-insulator-silicon (MIS) solar cells with and without grain boundaries were fabricated using polycrystalline Czochralski silicon. Scanned laser spot methods were used to provide high resolution photocurrent and surface reflection images of these cells. Electrically active grain boundaries, revealed by suppressed photocurrent collection, did not correlate perfectly with etch-produced surface features. For the laser wavelength (6328 A) an effective photocurrent loss of 30 to 40% occurred over a 16 μm width at grain boundaries. Comparisons of short-circuit current versus open-circuit voltage over a wide range of irradiance values were made on cells with and without grain boundaries. For a typical polycrystalline cell the air mass one photocurrent loss was 8%, whereas a 3% loss was determined for the laser excitation. The open-circuit voltage reduction was about 25 mV, implying an opposing current density associated with grain boundary walls of about 50% of that for the MIS barrier.

37832 Study of grain boundaries in GaAs by scanning light microscopy. Fletcher, R.M.; Wagner, D.K.; Ballantyne, J.M. (Cornell Univ., Ithaca, NY). Contract EG-77-C-03-1712. *Sol. Cells;* **1**: No. 3, 263-270(May 1980).

Scanning light microscopy was used to investigate the electronic properties of grain boundaries in GaAs. Measurements of the short-circuit photocurrent across the grain boundary in bicrystal specimens reveal directly the presence or absence of internal electric fields at the boundary. It was found that when fields are present the I-V characteristic is non-ohmic and when they are absent it is ohmic. In the non-ohmic case there is a substantial potential barrier (0.8 eV) at the grain boundary, the height of which is determined by a study of the zero-bias resistance as a function of temperature. The diffusion of minority carriers to the edge of the space charge region associated with the barrier is observed directly in the structure of the photocurrent, allowing a direct determination to be made of the minority carrier diffusion length adjacent to the grain boundary. The behaviors of photovoltage and photocurrent under bias are also discussed, and it is shown that the latter yields information about the barrier height associated with the normally depleted surface.

37833 Experimental determination of the photon economy in polycrystalline thin film photovoltaic materials and devices. Bragagnolo, J.A.; Fagen, E.A. (Univ. of Delaware, Newark). *Sol. Cells;* **1**: No. 3, 275-283(May 1980).

An experimental approach using directional spectral reflectance and absorptance measurements with 4π collection geometry is described which provides an expedient route to the determination of device photon losses, intrinsic optical properties of polycrystalline materials and the effects of layer morphology on the photon economy of solar cells. This technique is applied to the photon loss analysis of thin film CdS/Cu_2S cells and the assessment of Zn_3P_2 as a photovoltaic material. It is concluded that cell morphology is a key contributor to the high photon efficiency of polycrystalline CdS/Cu_2S cells. Also, the discrepancy between bulk and thin film absorption edge data for Zn_3P_2 is reduced and the intrinsic absorption edge of evaporated films is revealed to be exponential. Other applications of this technique are discussed.

37834 Grain boundary effects and conduction mechanism studies in chromium metal-insulator-silicon solar cells on polycrystalline silicon. Anderson, W.A. (State Univ. of New York, Buffalo); Rajkanan, K.; Delahoy, A.E.; Hyland, S.L. Contract ET-78-R-03-1876. *Sol. Cells;* **1**: No. 3, 305-310(May 1980).

Chromium metal-insulator-silicon (MIS) solar cells fabricated on Wacker polycrystalline silicon and electron-beam-deposited thin film silicon were studied to determine current flow mechanisms. Wacker polycrystalline p-type silicon was shown to produce MIS solar cells which exhibit surface-state-controlled current for $T > 150$ K and tunneling-controlled current at lower temperatures. MIS cells on unpolished Wacker silicon are clearly space charge limited. Electron-beam-deposited polycrystalline silicon 20 - 30 μm thick has a conductivity which may be limited by the grain boundary trap density or the availability of free carriers. Surface state analysis, laser scan data and diffusion length studies also show the limitations which exist at grain boundaries of polycrystalline silicon.

37835 Measurement techniques in thin film polycrystalline materials and devices (solar cells). Charles, H.K. Jr.; King, R.J.; Ariotedjo, A.P. (PRC Energy Analysis Co., McLean, VA). Contract EG-77-C-01-4024. *Sol. Cells;* **1**: No. 3, 327-346(May 1980).

A discussion of the relevance and applicability of basic bulk material and single-crystal semiconductor measurement techniques to thin film polycrystalline materials and devices is presented. The measurement techniques emphasized include resistivity and the Hall effect. Basic parametric relations for resitivity and the Hall effect coefficient are presented together with a discussion of the modifications due to film thickness, grain size, grain boundary conductivity and the presence of a substrate. The use of other electronic measurement techniques (e.g. surface photovoltage, photoconductivity and capacitance-voltage methods) is reviewed. Automated materials characterization and analysis methods such as scanning electron microscopy, secondary ion mass spectrometry, Auger electron spectroscopy and x-ray crystallography are presented in their dual role of providing fundamental materials parameter values and of verifying results determined by other electronic methods. The technical literature is surveyed to determine the most widely applied thin film resistivity and Hall effect (mobility) analytical and experimental measurement methods. Widely used measurement techniqeus for other relevant parameters (e.g. minority carrier lifetime, diffusion length etc.) are also identified, and an estimate of their efficacy in yielding results (i.e. parameter values) for thin films consistent with overall device performance is made. The measurement approaches producing the most viable performance indicators are then analyzed for needed improvements, greater measurement reproducibility etc. 53 references.

37836 Impact of screen printing on the cost of solar cell metallization. Taylor, W.E.; Mardesich, N.; Gay, C.F. (Spectrolab Inc, Sylmar, Calif). *Trans. ASME;* **102**: No. 1, 55-58(Feb 1980).

A major cost element in the technology of solar cell fabrication for space application is formation of electrical contacts by evaporation of metals through shadow masks. Application of conductive ink pastes by screen printing provides several mechanisms for cost reduction. Screen printing techniques have been developed for fabrication of miniature electronic circuits on ceramic substrates. 5 refs.

37837 **Low cost thin-film CdS-based solar cells--progress and promise.** Barnett, A.M.; Meakin, J.D. (Univ of Del, Newark). *Trans. ASME;* **102**: No. 1, 80-85(Feb 1980).

The direct conversion of sunlight to electricity using thin film solar cells is potentially a low cost renewable source of energy. A major factor contributing to the low projected costs is the very small quantities of materials required as the active layers of the cells. The research and development necessary to achieve these high efficiencies will be described. The feasibility of an extremely low cost manufacturing process capable of producing solar cells costing 250 dollars/kW will discussed. 12 refs.

37838 **Etching of CdS films.** Shirland, F.A. (Westinghouse Research and Development Center, Pittsburgh, PA). Contract EG-77-C-03-1577. *Sol. Cells;* **1**: No. 2, 183-197(Feb 1980).

Preliminary data are reported of a study of how HCl attacks CdS films and how the attack is affected by changes in the etching parameters, particularly time, temperature and acid concentration. Etched CdS films and replicas of etched CdS film surfaces were examined by scanning electron microscopy (SEM) and selected SEM photographs are presented to illustrate the effects. It is shown that etching textures the front surface of the CdS films and forms deep pits into the films. Pitting is the factor which varies most widely on differently processed films and which seems to correlate with the output level achievable from solar cells made from such films. The underlying substrate seems to be the factor having most influence on the etch pits.

BIOMASS PRODUCTION AND CONVERSION

REFER ALSO TO CITATION(S) 37791, 37793, 37794, 37797, 37798, 38314, 38806

37839 (DOE/CS/20122—01) **Biomass energy systems program summary.** (OAO Corp., Washington, DC (USA)). Jul 1980. Contract AC01-77ET21059;AC01-78ET20122. 220p. NTIS, PC A10/MF A01.

Research programs in biomass which were funded by the US DOE during fiscal year 1978 are listed in this program summary. The conversion technologies and their applications have been grouped into program elements according to the time frame in which they are expected to enter the commercial market. (DMC)

37840 (DOE/ER/00888—3) **Multidisciplinary research program directed toward utilization of solar energy through bioconversion of renewable resources.** (Georgia Univ., Athens (USA). Dept. of Microbiology). Jul 1980. Contract AS09-76ER00888. 128p. NTIS, PC A07/MF A01.

Progress is reported in this multidisciplinary research program. Genetic selection of superior trees, physiological basis of vigor, tissue culture systems leading to cloning of diploid and haploid cell lines are discussed in the Program A report. The physiological basis of enhanced oleoresin formation in southern pines when treated with sublethal concentrations of the herbicide paraquat was investigated in Program B. In Program C, metabolic changes in the stems of slash pine, in vivo, after application with paraquat were determined. The use of phdoem and xylem tissue slices as a laboratory model for studying paraquat associated- and normal-terpene synthesis in pines is discussed. The biochemistry and physiology of methane formation from cellulose during anaerobic fermentation are discussed in the Program D report. (DMC)

37841 (DOE/ET/20045—T1) **Recovery of above-ground woody biomass using operational modifications of conventional harvesting systems.** Herschelman, J.W.; Domenech, D.W. (Alabama A and M Univ., Normal (USA)). 1 Jun 1980. Contract FG01-78ET20045. 51p. NTIS, PC A04/MF A01.

Two harvesting systems were assembled during each of two summers to compare the operational efficiency of a whole tree harvesting system with a conventional harvesting system. Skidding of whole trees proved to be 27% more efficient than the skidding of primary stems because of operators habits of underutilizing skidder capacity. Although 5% more gals/hour were used by the whole tree system, there was a net gain of 21% more tons/gal. produced by this same system. A whole tree chipper was analyzed for its potential to process large hardwood trees for energy products. A comparison of five harvesting systems revealed that whole tree systems producing sawtimber, round pulpwood and energy chips proved most energy efficient and economically viable. A variety of machine/system factors were measured. It was determined that with certain modifications, whole tree chippers offer the best potential for processing logging residue for fuel. Forty-eight equations were developed predicting green and ovendry weights in summer and winter for whole tree weight, primary product weight, and the weight of limbs and tops for hardwood trees associated with the oak-hickory forest type in the Southern Appalachian Region based on diameter at breast height and whole tree length. Eight sawlog prediction equations were also developed based on log length, diameter small end outside bark and diameter large end outside bark. The energy efficiency of harvesting systems was studied by analyzing the equipment involved in manual and mechanized shortwood, longwood, and whole tree systems.

37842 (DOE/ET/20593—T2) **Cultural treatment of selected species for woody biomass fuel production in the Pacific Northwest. Final fiscal report, August 1, 1978-July 31, 1979.** Oliver, C. (Seattle City Light, WA (USA)). 1979. Contract FG01-78ET20593. 13p. NTIS, PC A02/MF A01.

The first year of a five-year study of the feasibility of growing trees as fuel for energy production is reported. During the first year, City Light established a fuel farm where the performance of red alder and black cottonwood on a short rotation, less than 20-year harvest cycle, is being evaluated. The response to stocking density, fertilization, irrigation, cultivation, and spacing variations is being monitored. (MHR)

37843 (DOE/ET/20593—T3) **Cultural treatment of selected species for woody biomass production in the Pacific northwest. Annual report.** (Seattle City Light, WA (USA)). Feb 1980. Contract FG01-78ET20593. 37p. NTIS, PC A03/MF A01.

Progress was made toward establishing two sites to study the effect of cultural treatment on two selected species, black cottonwood and red alder, for woody biomass production. The first study area (the dry site), located on the City of Seattle's Cedar River Watershed, at North Bend, Washington, was established and put into production during late winter 1978 and spring of 1979. Cottonwood cuttings obtained from US Forest Service land near Skykomish, Washington, were cut into 18 to 20 inch lengths and outplanted in March and April. Alder was obtained from logging roads near the plantation site as wildlings and transplanted immediately after pulling. Both species were planted in pure plots, mixes of 1:1, and mixes of 2:1 with spacings of 2x4, 4x6 and 6x8 feet. Row cultivation was performed three times during the growing season. Fertilizer and irrigation were not applied due to logistical problems. Survival for both species exceeded 98%. Growth was moderate to poor because of an extremely dry summer. The second area (the wet site) is being established on the University of Washington's Lee Experimental Forest north of Woodinville, Washington. The area was clearcut logged in September and October of 1979. Stumps were removed shortly thereafter.

37844 (DOE/EV—0108) **Alcohol production from agricultural and forestry residues.** Dale, L.; Opilla, R.; Surles, T. (Argonne National Lab., IL (USA)). Sep 1980. Contract W-31-109-ENG-38. 56p. NTIS, PC A04/MF A01.

Technologies available for the production of ethanol from whole corn are reviewed. Particular emphasis is placed on the environmental aspects of the process, including land utilization and possible air and water pollutants. Suggestions are made for technological changes intended to improve the economics of the process as well as to reduce some of the pollution from by-product disposal. Ethanol may be derived from renewable cellulosic substances by either enzymatic or acid hydrolysis of cellulose to sugar, followed by conventional fermentation and distillation. The use of two agricultural residues - corn stover (field stalks remaining after harvest) and straw from wheat crops - is reviewed as a cellulosic feedstock. Two processes have been evaluated with regard to environmental impact - a two-stage acid process developed by G.T. Tsao of Purdue University and an enzymatic process based on the laboratory findings of C.R. Wilke of the University of California, Berkeley. The environmental residuals expected from the manufacture of methyl and ethyl alcohols from woody biomass are covered. The methanol is produced in a gasification process, whereas ethanol is produced by hydrolysis and fermentation processes similar to those used to derive ethanol from cellulosic materials.

37845 (DOE/PE/70090—01) **Assessment of industrial activity in the utilization of biomass for energy.** (Booz, Allen and Hamilton, Inc., Bethesda, MD (USA)). Sep 1980. Contract AC03-79PE70090. 201p. NTIS, PC A10/MF A01.

The objective of this report is to help focus the federal programs in biomass energy, by identifying the status and objectives of private sector activity in the biomass field as of mid-1979. In addition, the industry's perceptions of government activities are characterized. Findings and conclusions are based principally on confidential interviews with executives in 95 companies. These included forest products companies, agricultural products companies, equipment manufacturers, electric and gas utilities petroleum refiners and distributors, research and engineering firms, and trade organizations, as listed in Exhibit 1. Interview findings have been supplemented by research of recent literature. The study focused on four key questions: (1) what is the composition of the biomass industry; (2) what are the companies doing; (3) what are their objectives and strategies; and (4) what are the implications for government policy. This executive summary provides highlights of the key findings and conclusions. The summary discussion is presented in seven parts: (1) overview of the biomass field; (2) structure of the biomass industry

today; (3) corporate activities in biomass-related areas; (4) motivations for these activities; (5) industry's outlook on the future for energy-from-biomass; (6) industry's view of government activities; and (7) implications for Federal policy.

37846 Breeding improvement of rubber yield in guayule. Sixth progress report, June 2, 1980. Hanson, G.P. Washington, DC; National Science Foundation (1980). 206p. (CONF-8004109—(Exc.)).

From 3. international guayule conference; Pasadena, CA, USA (29 Apr 1980).

Copies of the papers presented at the 3rd International Guayule Conference held in Pasadena, CA, are presented. Topics covered include: breeding for high rubber yield and improved adaptation in guayule; distribution and ecology of native guayule populations in Mexico; harvesting and cleaning bulk guayule seeds; guayule propagation and growth under greenhouse conditions; interspecific hybridization; selection for high rubber yield in guayule; isozyme variations in Parthenium and their inheritance during guayule interspecific hybridization; evaluating resistance to verticillum wilt disease in species of Parthenium; Phytophthora root rot disease, and other pests of guayule culture; distribution of rubber and comparative stem anatomy of high and low rubber guayule from Mexico; and growth studies of cultivated guayule. (DMC)

37847 (PB—80-804214) Wood as a fuel (citations from the NTIS data base). Report for 1964-Jan 80. Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Feb 1980. 54p. NTIS PC N01/MF N01.

Government funded studies dealing with availability, combustion characteristics, economics, and feasibility of using wood and wood wastes as fuel are discussed. Most abstracts pertain to wood- or bark-fired systems used to produce steam and electricity. Studies dealing with the use of wood to produce synthetic fuels are excluded. (Contains 47 abstracts)

37848 (SAND—80-0073) Considerations for biomass energy systems. Carson, C.C.; Hart, C.M. (Sandia National Labs., Albuquerque, NM (USA)). May 1980. Contract AC04-76DP00789. 80p. NTIS, PC A05/MF A01.

Several different biomass forms, or feedstocks, contribute to the total potential for biomass energy. A summary of the energy potential of the US biomass resource base is presented along with a survey of existing thermochemical and biochemical processes for converting the feedstocks into usable energy products. Energy requirements, economics, and alternate uses for biomass resources are included in the discussion. It is concluded that the current biomass resources could provide up to 2.5 EJ of usable energy and that with a concentrated, long-term program this contribution could grow to between 10 and 15 EJ. The biomass feedstock with the largest potential is wood, which provides more than half of the estimated total.

37849 (DOE/ET—20074) Eucalyptus plantations for energy production in Hawaii. (BioEnergy Development Corp., Hilo, HI (USA)). [nd]. Contract FC03-78ET20074. 7p. NTIS, PC A02/MF A01.

The feasibility of growing eucalyptus to replace part of the fuel oil in Hawaiian power plants is explored. The first 100 acres of the plantation have been planted; greenhouses for seedlings have been constructed; and future plans are described. (MHR)

PHOTOCHEMICAL, PHOTOBIOLOGICAL AND THERMOCHEMICAL CONVERSION

REFER ALSO TO CITATION(S) 38457, 38483

37850 (SERI/PR—9276-T1) Electrochemical photovoltaic cells/stabilization and optimization of II-VI semiconductors. First technical progress report, 15 April 1980-30 June 1980. Noufi, R.; Tench, D.; Warren, L. (Rockwell International Corp., Thousand Oaks, CA (USA)). 20 Jul 1980. Contract AC02-77CH00178. 23p. NTIS, PC A02/MF A01.

The overall goal of this program is to provide the basis for designing a practical electrochemical solar cell based on the II-VI compound semiconductors. Emphasis is on developing new electrolyte redox systems and electrode surface modifications which will stabilize the II-VI compounds against photodissolution without seriously degrading the long-term solar response. The bulk electrode material properties are also being optimized to provide the maximum solar conversion efficiency and greatest inherent electrode stability. Factors limiting the short circuit current of the n-CdSe/methanol/ferro-ferricyanide system to 17.5 mA/cm^2 have been identified. The principal limiting factor is apparently specific adsorption of hexacyanoferrate species on the electrode surface which occurs at higher redox couple concentrations and slows the overall charge transfer process. Ion pairing also occurs, resulting in a low mass transport rate (smaller diffusion coefficients and increased solution viscosity), and probably enhances the degree of specific adsorption. Improvements in the performance of this system will require mitigation of the interactions between the redox species and the electrode surface, e.g., via electrolytes with reduced ion-pairing tendencies or the use of electrode surface films. Photoelectrochemically generated polypyrrole films have been shown to protect CdX photoanodes from dissolution while permitting electron exchange with the electrolyte. Current effort is directed toward improving the film adhesion and optimizing the performance characteristics.

37851 (SERI/TR—8002-T1) Electrochemical photovoltaic cells/stabilization and optimization of II-VI semiconductors. Final technical report. Noufi, R.; Tench, D.; Warren, L. (Rockwell International Corp., Thousand Oaks, CA (USA)). May 1980. Contract AC02-77CH00178. 73p. NTIS, PC A04/MF A01.

The overall goal of this program is to provide the basis for designing a practical electrochemical solar cell based on the II-VI compound semiconductors. Emphasis is on developing new electrolyte redox sytems and electrode surface modifications which will stabilize the II-VI compounds against photodissolution without seriously degrading the long-term solar response. The bulk electrode material properties are also being optimized to provide the maximum solar conversion efficiency and greatest inherent electrode stability. Stabilization of n-CdSe against photodissolution has been achieved for the methanol/tetraethylammonium ferro-ferricyanide system. No degradation of the photocurrent or the electrode surface, even in the presence of traces of water, has been observed for runs up to 700 h at 6 mA/cm^2 and ~ AM1 light intensity. With higher quality single crystal CdSe, stable sort-circuit photocurrents of 15 to 17 mA/cm^2 and an open circuit voltage of 0.7 V (tungsten-halogen illumination) have been obtained, corresponding to a conversion efficiency of about 5%. Preliminary evaluation of a series of sulfur-containing 1,2-dithiolene metal complexes for stabilization of CdX photoanodes in acetonitrile solution has been completed. For the first time, a conducting polymer film (derived from pyrrole) has been electrochemically deposited on a semiconductor electrode. This could represent a breakthrough in the use of hydrophobic films to protect semiconductor photoanodes from dissolution/degradation. Mixed CdSe-CdTe solid solution electrodes were found to exhibit a minimum in both the flatband potential and the bandgap at ~ 65% CdTe. Both of these shifts would have a detrimental effect on the solar conversion efficiency.

37852 Semiconductor electrodes. 31. Photoelectrochemistry and photovoltaic systems with n- and p-type WSe_2 in aqueous solution. Fan, F.R.F.; White, H.S.; Wheeler, B.L.; Bard, A.J. (Univ. of Texas, Austin). *J. Am. Chem. Soc.;* **102**: No. 16, 5142-5148(30 Jul 1980).

The photoelectrochemical (PEC) behavior of n- and p-type WSe_2 single crystal electrodes in aqueous solutions containing a number of redox couples (Br_2/Br^-, Fe^{3+}/Fe^{2+}, I_2/I^-, $Fe(CN)_6^{3-}/Fe(CN)_6^{4-}$, and MV^{2+}/MV^+, where MV is methylviologen) was investigated. The results are consistent with a model of the interface where ideal behavior is approached with some couples but recombination effects are important with others. The characteristics of several PEC cells are described. The n-WSe_2/I_3^- (0.025 M), I^- (1.0 M)/Pt cell showed a 0.71-V open circuit voltage, 65 mA/cm^2 short circuit current, 0.46 fill factor, and ~ 14% power efficiency under 150 mW/cm^2 red light irradiation. A rechargeable PEC cell based on the p-WSe_2/MV^{2+},I^-/n-WSe_2 system was constructed. Photoproduction of H_2 and I_2 with such a cell is also described.

37853 Reactions in microemulsions. V. Effect of surface charge and reaction products on a chlorin-sensitized photoreaction. Jones, C.A.; Weaner, L.E.; Mackay, R.A. (Drexel Univ., Philadelphia, PA). *J. Phys. Chem.;* **84**: No. 12, 1495-1500(12 Jun 1980).

The kinetics of the chlorin-(chlorophyll a and pheophytin a) sensitized photoreduction of methyl red by ascorbate has been examined in oil-in-water microemulsions of three surfactant charge types: anionic, neutral, and cationic. In all cases, the reaction remains zero order in oxidant and exhibits saturation (limiting quantum yield) at high reductant concentration. When a pH 7 buffer is employed as the aqueous phase, the limiting quantum yield decreases in the order anionic > neutral > cationic. However, the reverse order obtains for the initial increase of quantum yield with ascorbate concentration. In both cases, the results are ascribed primarily to the effect of surface charge on local concentrations of ionic species (hydrogen ion and ascorbate monoanion), although there does appear to be some contribution from nonelectrostatic effects. One of the products of the chemical reduction of methyl red, N,N-dimethyl-p-phenylenediamine, has been found to increase quantum yield two- to threefold.

37854 Concept of Fermi level pinning at semiconductor/liquid junctions. Consequences for energy conversion efficiency and selection of useful solution redox couples in solar devices. Bard, A.J.; Bocarsly, A.B.; Fan, F.R.F.; Walton, E.G.; Wrighton, M.S. (Univ. of Texas, Austin). *J. Am. Chem. Soc.;* **102**: No. 11, 3671-3677(21 May 1980).

Fermi level pinning refers to a situation where the band bending in a semiconductor contacting a metal is essentially independent of the metal even for large variation in the work function of the metal. It was found that a similar situation sometimes results for a

semiconductor contacting liquid electrolyte solutions containing redox couples having very different electrochemical potentials. Recently, workers in the field of semiconductor photoelectrochemistry have emphasized a limiting case of the model of the semiconductor/liquid interface where the drop across the semiconductor depends on applied potential; at equilibrium with the solution, the band bending is generally regarded as varying with changes in the solution potential by virtue of changes in the redox couple or simply changing the ratio of oxidized and reduced material. Fermi level pinning results in semiconductor/liquid interfaces which can be viewed as analogous to a Schottky barrier photocell in series with an electrochemical cell in that the extent to which a given redox process can be driven uphill is independent of the potential of the redox couple.n-GaAs, p-GaAs, p-GaAs, and p-Si are semiconductors that exhibit Fermi level pinning in liquid electrolyte solutions ($CH_3CN/[n\text{-}Bu_4N]ClO_4$) of redox reagents. Fermi level pinning has the disadvantage in practical terms of limiting photovoltage in optical energy conversion applications, but such a phenomenon allows the use of a very wide range of solution couples. Since Fermi level pinning results from surface states, changes in the surface brought about by deliberate surface chemistry may change the surface states and hence the photovoltage in solid-state and liquid-junction solar devices.

37855 Photoreduction at illuminated p-type semiconducting silicon photoelectrodes. Evidence for Fermi level pinning. Bocarsly, A.B.; Bookbinder, D.C.; Dominey, R.N.; Lewis, N.S.; Wrighton, M.S. (Massachusetts Inst. of Tech., Cambridge). *J. Am. Chem. Soc.;* **102**: No. 11, 3683-3688(21 May 1980).

Studies of p- and n-type Si electrodes are reported which show that semiconducting Si electrode surfaces do not allow efficient H_2 evolution in the dark (n type) or upon illumination with band gap or greater energy light (p type). The key experiment is that N,N'-dimethyl-4,4'-bipyridinium (PQ^{2+}) is reversibly reduced at n-type Si in aqueous media at a pH where H_2 should be evolved at nearly the same potential, but no H_2 evolution current is observable. The PQ/sup 2+/+/.system may be useful as an electron-transfer mediator, since PQ^+.can be used to effect generation of H_2 from H_2O using a heterogeneous catalyst. The PQ^+.can be produced in an uphill sense by illumination of p-type Si in aqueous solutions. Studies of p-type Si in nonaqueous solvents show that PQ^{2+}, PQ^+., $Ru(bpy)_3^{2+}$, $Ru(bpy)_3^+$, and $Ru(bpy)_3^0$ are all reducible upon illumination of the p-type Si. Interestingly, each species can be photoreduced at a potential ~ 500 mV more positive than at a reversible electrode in the dark. This result reveals that a p-type Si-based photoelectrochemical cell based on PQ/sup 2+/+/., PQ/sup +/1%/, $Ru(bpy)_3$/sup 2+/+/, $Ru(bpy)_3$/sup +/0/, or $Ru(bpy)_3$/sup 0/-/ would all yield a common output photovoltage, despite the fact that the formal potentials for these couples vary by more than the band gap (1.1 V) of the photocathode. These data support the notion that p-type Si exhibits Fermi level pinning under the conditions employed.Surface chemistry is shown to be able to effect changes in interface kinetics for electrodes exhibiting Fermi level pinning.

37856 Use of chemically derivatized n-type silicon photoelectrodes in aqueous media: photooxidation of iodide, hexacyanoiron(II), and hexaammineruthenium(II) at ferrocene-derivatized photoanodes. Bocarsly, A.B.; Walton, E.G.; Wrighton, M.S. (Massachusetts Inst. of Tech., Cambridge). *J. Am. Chem. Soc.;* **102**: No. 10, 3390-3398(7 May 1980).

A procedure is described for the chemical derivatization of the surface of n-type semiconductor photoanodes to yield photosensitive interfaces for use in a large number of thermodynamically uphill oxidation processes. (1,1'-ferrocenediyl)dichlorosilane was used to derivatize n-type Si to yield a photoanode that can be used under conditions where the naked (nonderivatized) n-type Si undergoes photoanodic corrosion yielding an insulating SiO/sub x/ surface layer. The results of use of this derivatized n-type Si in aqueous solutions to investigate the photooxidation of iodide, hexacyanoiron(II), and hexaammineruthenium(II) are reported. This type photoelectrode has an operation range that is nearly ideal from the point of solar energy conversion. (BLM)

PHOTOVOLTAIC POWER SYSTEMS

REFER ALSO TO CITATION(S) 37815, 37884, 38644, 38906, 38907, 38908

37857 (CONF-800491—, pp 193-195) **SPS program review transportation perspective.** Wales, W.W. Jr. (Marshall Space Flight Center, Huntsville, AL). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

During the past four years the NASA has teamed with various organizations in industry to assess the technical feasibility and economic viability of the Satellite Power System (SPS). The transportation system required to support this program is briefly discussed. The SPS program requirement for the construction of two 35-million kilogram (5- GW) satellites each year demands that approximately 300,000 kilogram (660,000 pounds) of mass per day be delivered to the construction site, at geosynchronous orbit. The transportation system represents a significant part of the overall program cost, from 35 to 40 percent. Payload delivery cost goals of 15 to 30 dollars per kilogram of mass means that the system elements must have long life, short turnaround times with minimum maintenance, and minimum unit and design/development costs. Orbital mass deliveries will require multiple launches each day, therefore environmental impacts must be considered and held to a minimum. (WHK)

37858 (CONF-800491—, pp 196-199) **Minimum cost criteria for SPS transportation to GEO.** Koelle, D.E. (MBB Space Division, Ottobrunn, Germany). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The transportation of 50,000 tons (Mg) mass to GEO, as presently estimated for a 5 GW SPS, poses a great challenge to system design and technology, especially however to economic optimization. Required is a heavy cargo launch vehicle with more than 200 Mg payload in geosync. orbit (GEO), requiring up to some 250 launches for one SPS. A cost-optimized vehicle of this size seems to be able to realize a range of 50 to 150 $/kg (1980) specific transportation cost to GEO. This is more than two orders of magnitude lower than the Space Shuttle plus IUS (23,000 $/kg). However, the range indicated means 2 to 6 billion dollars launch cost for one 5 GW SPS, or about one-third up to the same amount as the SPS space segment will cost. For this reason, a strict application of cost optimization has to be applied in vehicle design and not only a performance optimization as in the past; cost optimization is discussed. (WHK)

37859 (CONF-800491—, pp 200-203) **Earth-to-orbit transportation for solar power satellites.** Woodcock, G.R.; Hanley, G. Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

Transportation of solar power satellites to space will require cargo transport capability much greater than any other space technology application thus far investigated. The cost of space transportation operations represents, in the reference SPS system, more than one-fourth of the total production cost of the SPS's, even though the unit cost in dollars per kilogram is projected to be much less than that presently foreseen for the Space Shuttle. Three-fourths of the cost is contributed by the launch systems (including launches delivering orbit transfer propellant) with the remainder contributed by orbit transfer systems. Further, developing the vehicles required and acquiring the operational vehicle fleet is the largest single element of SPS nonrecurring cost. Consequently, the design approach for these vehicles and their ability to achieve the projected cost is of great importance to the economic practicality of solar power satellites. The history of SPS launch vehicle evolution is discussed. (WHK)

37860 (CONF-800491—, pp 204-207) **Orbit-to-orbit transportation.** Bergeron, R.P. Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The Satellite Power System (SPS) program necessitates the transfer of significant cargo mass and personnel from low earth orbit (LEO) to geosynchronous earth orbit (GEO). The SPS transportation costs represent a major portion of program funding requirements and therefore require a most cost-effective approach toward LEO-GEO transfer; various concepts and options are discussed. (WHK)

37861 (CONF-800491—, pp 208-209) **Offshore space center (offshore launch site).** Hervey, D.G. Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

An Offshore Space Center (OSC) from which space vehicles could be launched into and returned from orbit, is described as a logical concept for development of the high level of space activity expected in the not too distant future. The OSC provides substantial benefits as a support base and launch site for such a pattern of use. Any activity which requires the development of a heavy launch lift vehicle (HLLV) will benefit by operation from an OSC. Cost, operational, and political advantages make the OSC an attractive concept. Operating from near the equator provides a twenty percent increase in payload in an ecliptic plan orbit. The offshore site, in international waters, will function as a central location, easily reached by earthbound transportation from worldwide sources of materials which must be launched into space. The remote location in international waters isolates the launch operations (e.g. noise) from population centers and from some other major potential environmental objectives. Such an OSC site provides independence from foreign control. Acceptable sites exist, affording a mild climate with excellent weather and orbital windows for each orbit around the earth.

37862 (CONF-800491—, pp 210-213) **Applicability of MPD thrusters to satellite power systems.** Jones, R.M.; Rudolph, L.K. (Jet Propulsion Lab., Pasadena, CA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The magnetoplasmadynamic (MPD) thruster is currently under development at JPL for a range of applications including deep space propulsion, near Earth payload transportation, and station-keeping and attitude control of large space structures. Recent experiments tend to confirm past projections that specific impulses from 1000 to 5000 seconds at efficiencies exceeding 50% can be obtained with argon propellant. The operation, performance, and possible applications of MPD thrusters are discussed. (WHK)

37863 (CONF-800491—, pp 214-215) **Satellite power systems (SPS) space transportation workshop summary.** Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

37864 (CONF-800491—, pp 223-226) **Recent work on use of lunar materials for SPS construction.** O'Neill, G.K. (Princeton Univ., NJ). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

During 1978 and 1979 several workshops were held under the sponsorship of the Space Studies Institute. Experts in spacecraft design, rocket mission optimization, mass-driver design, chemical processing and industrial automation took part in these workshops. The purpose of the workshops was to extend in a logical way the concepts of scaling and bootstrapping studied earlier in 1976 and 1978 NASA studies on the use of nonterrestrial materials. In the latest work, the group examined first the question of how small an operation could be mounted that would make a productive use of the lunar materials. In that operation, as far as possible only equipment being developed by NASA for other purposes would be used (the Shuttle itself, without augmentation, small crew workstations, spacesuits, a conventional chemically-powered orbital transfer vehicle, and whatever minimal tele-operators are developed in the course of the next few years). The interim conclusion of the workshop group is that the concepts of scaling, bootstrapping, and replication appear certain to provide major cost savings in any program, such as that of the SPS, which requires the emplacement of large payloads in high Earth orbit. It is also clear that there is great value in an approach of that kind, which can achieve high return on a modest investment without exceeding the lift capabilities of the unaugmented Shuttle system. (WHK)

37865 (CONF-800491—, pp 227-230) **Contribution to the availability of lunar resources for powersat construction.** Heppenheimer, T.A. (Center for Space Science, Fountain Valley, CA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

A number of authors have discussed the use of lunar resources in powersat construction, wherein these resources are to be transported with the aid of a lunar mass-driver. Previous contributions by the present author have included studies of achromatic trajectories and of the mass-catcher and associated transfer trajectories to a space manufacturing facility. An important problem, heretofore essentially untreated, is the minimization of cross-track errors in the launch of payloads by mass-driver. This problem is discussed. (WHK)

37866 (CONF-800491—, pp 301-302) **SPS construction perspective/summary.** Benson, H.E. (Johnson Space Center, Houston, TX). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

37867 (CONF-800491—, pp 303-306) **Integrated space operations overview.** Woodcock, G.R. (Boeing Aerospace Co., Seattle, WA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

37868 (CONF-800491—, pp 307-309) **Specific construction tasks.** McRae, W.V. JR. (Rockwell International, Huntsville, AL). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

37869 (CONF-800491—, pp 310-315) **Specific SPS construction studies: construction tasks-construction base.** McCaffrey, R.W. (Grumman Aerospace Corp., Bethpage, NY). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

A concept for building the 5000 MW reference Solar Power Satellite in earth orbit, based on recent work performed for NASA/JSC under contract to Boeing, on the SPS System Definition Study, and on related work performed under Grumman IRAD, is discussed.

37870 (CONF-800491—, pp 622-624) **Critical review of satellite power systems (SPS) space transportation cost estimates.** Earhart, R.W.; Hamilton, C.W.; Maher, K.; Teeter, R.R. (Battelle Columbus Labs., Ohio). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

37871 (DOE/ET/20279—103) **Solar photovoltaic/thermal residential experiment. Phase I. Final report.** Darkazalli, G. (Texas Univ., Arlington (USA); Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 1 Jul 1980. Contract AC02-76ET20279. 54p. NTIS, PC A04/MF A01.

Month-by-month energy transfer data between an occupied residence and its energy supply systems are presented. The data were obtained during the first phase of photovoltaic/thermal residential research conducted at the University of Texas at Arlington/Solar Energy Research Facility. This research was part of the US Department of Energy Photovoltaic/Thermal Project managed by the M.I.T. Lincoln Laboratory. Energy transfer data are divided into different categories depending on how the energy is consumed. Energy transfers between some system components are also categorized. These components include a flat-plate thermal collector array, a flat-plate photovoltaic array, a dc-to-ac inverter, thermal storage tanks, and a series heat pump. System operations included directing surplus electrical energy (generated by the photovoltaic array) into the local utility grid. The heat pump used off-peak utility power to chill water during the cooling season.

37872 (DOE/EV—0101) **Decentalized solar photovoltaic energy systems.** Krupka, M.C. (Los Alamos Scientific Lab., NM (USA)). Sep 1980. Contract W-7405-ENG-36. 111p. NTIS, PC A06/MF A01.

Environmental data for decentralized solar photovoltaic systems have been generated in support of the Technology Assessment of Solar Energy Systems program (TASE). Emphasis has been placed upon the selection and use of a model residential photovoltaic system to develop and quantify the necessary data. The model consists of a reference home located in Phoenix, AZ, utilizing a unique solar cell array-roof shingle combination. Silicon solar cells, rated at 13.5% efficiency at 28°C and 100 mW/cm² (AMI) insolation are used to generate ~ 10 kW (peak). An all-electric home is considered with lead-acid battery storage, dc-ac inversion and utility backup. The reference home is compared to others in regions of different insolation. Major material requirements, scaled to quad levels of end-use energy include significant quantities of silicon, copper, lead, antimony, sulfuric acid and plastics. Operating residuals generated are negligible with the exception of those from the storage battery due to a short (10-year) lifetime. A brief general discussion of other environmental, health, and safety and resource availability impacts is presented. It is suggested that solar cell materials production and fabrication may have the major environmental impact when comparing all facets of photovoltaic system usage. Fabrication of the various types of solar cell systems involves the need, handling, and transportation of many toxic and hazardous chemicals with attendant health and safety impacts. Increases in production of such materials as lead, antimony, sulfuric acid, copper, plastics, cadmium and gallium will be required should large scale usage of photovoltaic systems be implemented.

37873 (DOE/JPL/955367—80/1(Exec.Summ.)) **Photovoltaic module electrical termination design requirement study.** Mosna, F.J. Jr.; Donlinger, J. (Motorola, Inc., Phoenix, AZ (USA); ITT Cannon, Santa Ana, CA (USA)). Jul 1980. Contract NAS-7-100-955367. 42p. NTIS, PC A03/MF A01.

Motorola Inc., in conjunction with ITT Cannon, has conducted a study to develop information to facilitate the selection of existing, commercial, electrical termination hardware for photovoltaic modules and arrays. This volume of the report contains the executive summary. Module and array design parameters were investigated and recommendations were developed for use in surveying, evaluating, and comparing electrical termination hardware. Electrical termination selection criteria factors were developed and applied to nine generic termination types in each of the four application sectors: remote, residential, intermediate and industrial. Existing terminations best suited for photovoltaic modules and arrays were identified. Cost information was developed to identify cost drivers and/or requirements which might lead to cost reductions. The general conclusion is that there is no single generic termination that is best suited for photovoltaic application, but that the appropriate termination is strongly dependent upon the module construction and its support structure as well as the specific application sector.

37874 (EPRI-AP—1548) **Satellite power system: utility impact study. Final report.** Bohn, J.G.; Patmore, J.W.; Zaininger, H.W. (Systems Control, Inc., Palo Alto, CA (USA)). Sep 1980. 70p. NTIS, PC A04/MF A01.

A state-of-the-art summary of the solar satellite power system (SPS) concept currently being evaluated by the US Department of Energy (DOE) and the National Aeronautics and Space Administra-

tion (NASA) is given. Problems related to the integration of the SPS into conventional electric power systems are considered. The reference system design would utilize 60 satellites in geosynchronous orbits. Each satellite would collect solar energy and convert it to electricity by means of a 55 km² array of photovoltaic cells. This dc electricity would then be converted to microwaves and transmitted to a 130 km² receiving antenna on the ground, where it would be reconverted to dc and then ac electricity before being fed into the conventional utility power system. Each satellite would deliver approximately 5 GW of power at the utility interface. It is estimated that each 5 GW satellite and ground receiving antenna plus associated equipment would cost $10 to 20 billion (1977 dollars), with the entire 60 satellite system costing $600 billion to 1.2 trillion. This amounts to $2000 to 4000 per kW. Although there are serious technical problems to be solved before the SPS would be feasible, the cost of the system may be the greatest obstacle to its implementation. One of the chief technical problems with using SPS in a conventional power system derives from the eclipse periods which the SPS would undergo each spring and fall. The accompanying sudden loss and return of power would likely cause severe load following and spinning reserve problems for utilities. In addition, there are stability and reliability problems that must be resolved before the SPS could be implemented.

37875 (PB—80-802697) **Solar power satellites (citations from the International Aerospace Abstracts data base). Report for 1973-nov 79.** Zollars, G.F. (New Mexico Univ., Albuquerque (USA). Technology Application Center). Dec 1979. 88p. NTIS PC N01/MF N01.

This bibliography of citations to the international literature concerns the development of solar power satellites. The design and construction of the satellite solar arrays and the technology of satellite solar energy conversion and transmission to earth are the major topics covered. Feasibility Analyses of the solar power satellite concept are also included. (Contains 320 citations)

37876 (UCID—18776) **Six kilowatt, residential, photovoltaic power systems study: design, performance, economics, market potential.** Partain, L.D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Aug 1980. Contract W-7405-ENG-48. 58p. NTIS, PC A04/MF A01.

A cost and performance analysis is presented for a solar-cell-electric system that can provide 70% of the electric power to a home in a California-like climate. Both a battery storage and no-storage configuration with a six kilowatt, peak power, solar array are considered, including batteries, for a 15 kWh per day average energy use that equals that of an average household in Northern California. For example, systems with present purchase costs of $75,000 to $100,000 and estimated lifecycle energy cost of $2 to $3 per kWh are discussed along with projected reductions to purchase costs below $10,000 and lifecycle energy costs decreasing to $0.30 to $0.60 per kWh during the 1980's. Goals for the 1990's indicate that residential solar cell systems may be able to provide energy at costs that are competitive with other alternatives at $0.05 to $0.10-kWh for home electricity consumption and $0.32/kWh for transportation costs. For the promising, no-storage home system, the uncertainties in important parameter values are too large to allow definitive assessment until better characterizations have been made. The political and policy decisions that can have a strong influence are assessed and quantified. The effects of tax credits, utility buy-back, and proper home construction are considered. Potential markets in the hundreds of millions of dollars per year range that involve on the order of one million peak kilowatts of solar cells per year are estimated.

37877 **Overview of photovoltaic market research.** Costello, D.; Posner, D. (Solar Energy Research Inst., Golden, CO). *Sol. Cells;* **1**: No. 1, 37-53(Nov 1979).

Available information on current and potential markets for photovoltaics is compared and contrasted. The major markets considered are communications, cathodic protection, international agricultural pumping and remote general power, and US residential applications. Each of these markets is described by market size, competing power sources and system prices required for photovoltaics to compete. It is concluded that some growth in sales to communications and cathodic protection markets can be expected in the near term. International markets for agricultural pumping and general power systems show the greatest potential for sales in the early to mid 1980s. Major energy-displacing markets in the US, particularly in the residential sector, can be a large and profitable long-term market for photovoltaics.

SOLAR THERMAL POWER SYSTEMS

REFER ALSO TO CITATION(S) 37815, 37857, 37858, 37859, 37860, 37861, 37862, 37863, 37864, 37865, 37866, 37867, 37868, 37870, 37875, 37903, 38644, 38906, 38907, 38908

CENTRAL RECEIVER

REFER ALSO TO CITATION(S) 37878, 37879

DISTRIBUTED COLLECTOR

REFER ALSO TO CITATION(S) 37904

TOTAL ENERGY AND HYBRID SYSTEMS

37878 (SAN—1608-3-1) **Technical and economic assessment of solar hybrid repowering: conceptual design and cost estimate.** (Public Service Co. of New Mexico, Albuquerque (USA)). Sep 1978. Contract AC03-77ET20308. 226p. NTIS, PC A11/MF A01.

Reeves Unit No. 2 in Albuquerque, New Mexico, was established as the potential candidate plant for solar hybrid repowering. Under this conceptual design and cost estimate task, this plant was investigated to provide a reasonable definitive design and to identify the modifications required. The existing land situation, as well as the particular environmental aspects of Reeves Unit No. 2, was investigated. Upon complete definition a cost estimate was prepared which is relatable to the present configuration of Reeves Unit No. 2. A definition of all significant changes in the plant to accommodate the addition of the solar facilities, as well as the establishment of the integration of the control systems, was determined and estimated. A field was laid out using the MIRVAL program and established the power level that was available from a given configuration. Environmental aspects such as rainfall, cloud cover, dust, traffic hazards and others were considered in the conceptual design of this unit. A design utilizing 4289 heliostats in a field to the south of the existing station was conceived. The tower was set in the southern half of an oval teardrop shaped field with access roads, fencing, relocation of existing facilities and potential for maintenance of the solar facilities established. Further revisions and runs in MIRVAL varied the actual available heliostats to a finer degree; however, the 4289 heliostat power level was the basis used throughout for the potential power level. The potential problems were identified and various solutions defined with trade studies and engineering analysis. This conceptual design was developed to a level to establish a construction and program cost estimate.

37879 (SAN—1608-3-2) **Technical and economic assessment of solar hybrid repowering: conceptual design and cost estimate.** (Public Service Co. of New Mexico, Albuquerque (USA)). Sep 1978. Contract AC03-77ET20308. 124p. NTIS, PC A06/MF A01.

This volume contains the appendix to the conceptual design and cost estimate report on solar repowering the Reeves Unit No. 2 power plant in Albuquerque, New Mexico. Included are the engineering drawings and the work breakdown structure estimate report. (WHK)

OCEAN THERMAL GRADIENT AND SALINITY GRADIENT POWER SYSTEMS

37880 (ORNL—5639) **Enhancement of heat transfer for ammonia evaporating outside vertical tubes.** Mailen, G.S. (Oak Ridge National Lab., TN (USA)). Sep 1980. Contract W-7405-ENG-26. 119p. NTIS, PC A06/MF A01.

Experiments were conducted to determine the heat transfer performance of single vertical tubes with ammonia evaporating from a thin film on the outside of the tube. The three alumimum tubes employed were of 2.54-cm (1-in.) nominal diameter and 1.22-m (4-ft) length: the first tube had smooth inside and outside surfaces; the second one had a smooth inside surface, but 48 flutes on the outside; and the third tube had 34 flutes on the inside and 42 flutes on the outside. Three different ammonia feed rates [3.15 x 10^{-6} m³/s (0.05 gpm), 6.13 x 10^{-6} m³/s (0.10 gpm), and 15.77 x 10^{-6} m³/s (0.25 gpm)] were used in the tests for each tube, while the heat load was varied from 690 W (2360 Btu/h) to 3990 W (13,620 Btu/h). Evaporation heat transfer coefficients, based on the total tube outside surface area, are reported as composite coefficients, which include the resistances of both the evaporating film and the tube wall. Composite evaporation heat transfer coefficients ranged from 2720 W/m2.K (480 Btu/h.ft².°F) to 12,020 W/m².K (2120 Btu/h.ft².°F). In general, the largest heat transfer coefficients were obtained at the highest heat load and ammonia feed rate tested. Corresponding composite temperature differences ranged from 1.3°K (2.3°F) to 5.7°K (10.2°F), while reflux ratios, the ratio of ammonia feed rate to evaporation rate, ranged from 1.1 to 12.6. A brief photographic study illustrates the presence of boiling during some of the ammonia evaporation test runs. During thin film evaporation of ammonia, no appreciable heat transfer enhancement was obtained when utilizing fluted surfaces instead of smooth ones.

37881 (PB—80-127145) **An evaluation of oceanographic and socio-economic aspects of a nearshore ocean thermal energy conversion pilot plant in subtropical Hawaiian waters, brief summary. Summary report.** Bathen, K.H. (Hawaii Univ., Honolulu (USA). Dept. of Ocean Engineering). 1975. 10p. NTIS, PC A02/MF A01.

Study results of the nearshore application for ocean thermal energy conversion (OTEC) pilot plant studies in subtropical Hawaiian waters are reported. A three-part oceanographic and socio-economic study complted at Keahole Point, Kona coast, consisted of an extensive literature survey and a field program to characterize the local, physical, chemical, geological, and biological environments. Also conducted was an evaluation of the potential ocean environmental impact that a 20 MW pilot plant located at or just off Keahole Point would have on the local subtropical waters.

37882 (SERI/TR—631-627) **Mist lift analysis summary report.** Davenport, R.L. (Solar Energy Research Inst., Golden, CO (USA)). Sep 1980. Contract AC02-77CH00178. 43p. NTIS, PC A03/MF A01.

The mist flow open-cycle OTEC concept proposed by S.L. Ridgway has much promise, but the fluid mechanics of the mist flow are not well understood. The creation of the mist and the possibility of droplet growth leading to rainout (when the vapor can no longer support the mist) are particularly troublesome. This report summarizes preliminary results of a numerical analysis initiated at SERI in FY79 to study the mist-lift process. The analysis emphasizes the mass transfer and fluid mechanics of the steady-state mist flow and is based on one-dimensional models of the mist flow developed for SERI by Graham Wallis. One of Wallis's models describes a mist composed of a single size of drops and another considers several drop sizes. The latter model, further developed at SERI, considers a changing spectrum of discrete drop sizes and incorporates the mathematics describing collisions and growth of the droplets by coalescence. The analysis results show that under conditions leading to maximum lift in the single-drop-size model, the multigroup model predicts significantly reduced lift because of the growth of droplets by coalescence. The predicted lift height is sensitive to variations in the mass flow rate and inlet pressure. Inclusion of a coasting section, in which the drops would rise ballistically without change in temperature, may lead to increased lift within the existing range of operation.

37883 (SERI/TR—631-692) **Open-cycle OTEC system performance analysis.** Lewandowski, A.A.; Olson, D.A.; Johnson, D.H. (Solar Energy Research Inst., Golden, CO (USA)). Oct 1980. Contract AC02-77CH00178. 118p. NTIS, PC A06/MF A01.

An algorithm developed to calculate the performance of Claude-Cycle ocean thermal energy conversion (OTEC) systems is described. The algorithm treats each component of the system separately and then interfaces them to form a complete system, allowing a component to be changed without changing the rest of the algorithm. Two components that are subject to change are the evaporator and condenser. For this study we developed mathematical models of a channel-flow evaporator and both a horizontal jet and spray director contact condenser. The algorithm was then programmed to run on SERI's CDC 7600 computer and used to calculate the effect on performance of deaerating the warm and cold water streams before entering the evaporator and condenser, respectively. This study indicates that there is no advantage to removing air from these streams compared with removing the air from the condenser.

SOLAR THERMAL UTILIZATION

REFER ALSO TO CITATION(S) 38307

37884 (SERI/TP—641-773) **Quality-assurance needs and goals in solar energy conversion.** Gross, G.E. (Solar Energy Research Inst., Golden, CO (USA)). Jul 1980. Contract AC02-77CH00178. 9p. (CONF-800927—2). NTIS, PC A02/MF A01.

From 7. annual national energy division conference; Houston, TX, USA (29 Sep 1980).

A discussion of the status of quality assurance activities in solar energy conversion technologies and of the needs for further efforts in this area is presented. The importance of reliability and quality assurance activities to various end users is briefly discussed. Some details of such activities in wind, active heating and cooling, and photovoltaic technologies are given. Suggestions for an inegrated reliability, quality assurance program are presented and their importance to the growth of solar energy application is discussed.

SPACE HEATING AND COOLING

REFER ALSO TO CITATION(S) 37871, 38254

37885 (DOE/CS/30333—1) **Comal County Mental Health and Mental Retardation Center Passive Solar Demonstration Program. Final report.** Risner, P.S.; Stubblefield, J.; Deffenbaugh, D.M.; Stevenson, J. (Southwest Research Inst., San Antonio, TX (USA)). 31 Jul 1980. Contract FC02-80CS30333. 62p. NTIS, PC A04/MF A01.

An extensive energy analysis was performed on an existing schoolhouse built in New Braunfels, Texas, in the 1930's. The purpose of the analysis was to evaluate the potentials for passive solar retrofitting concepts and energy conservation techniques which could be applied to the structure on an economically justifiable basis. The energy analysis was performed by the Bin methodology, and a life cycle cost analysis was utilized in determining the economics of the alternatives under consideration. The alternatives which were considered were analyzed on an individual basis as to the percentage improvement in the existing structure's yearly energy loads which each option could be expected to provide. The life cycle cost analysis was based on the assumed useful life of the option; the estimated fuel savings the option provided; the initial investment required to incorporate the option into the retrofitted structure; and discount and fuel escalation rates of 10 and 12%, respectively. If the option provided a positive annual real savings over its assumed life, then the selection of the option was considered to be economically feasible. The selected options were subsequently combined into a revised construction package, and an energy/economic analysis was performed to estimate the annual savings which could be expected by the revisions. A conservative building temperature control strategy which consisted of turning off the mechanical equipment during unoccupied hours, and utilizing natural ventilation when applicable was also investigated. The options which were selected and the relative annual savings are given.

37886 (DOE/EV—0102) **Characterization and assessment of selected solar thermal energy systems for residential and process heat applications.** (Los Alamos Scientific Lab., NM (USA)). Sep 1980. Contract W-7405-ENG-36. 54p. NTIS, PC A04/MF A01.

The results of studies of seven solar thermal energy applications are presented. Five of these are residential applications: space heating-active liquid, space heating-active air, domestic hot water-active, space heating-passive, and space heating and cooling- active liquid. Denver, Colorado, was selected as a representative location for each of the above applications. The remaining two applications produce industrial process heat: a flat-piate collector system producing 50°C to 100°C hot water for a commercial laundry in Indianapolis, Indiana; and a concentrating collector system that could produce 100°C to 300°C process heat adequate to the needs of a pulp mill in Madison, Wisconsin. For each application, a representative system model and preliminary designs of major system elements were established. Then the following data were generated: annual useful energy produced, type and weight of the basic component materials, environmental residuals generated during system operation, and land and water requirements. These data were generalized for other TASE study purposes by expressing them as quantities per 10^{15} Btu of useful energy. The system characteristics are discussed and the environmental impacts are evaluated. To allow the reader to estimate system performance at other geographic locations than those studied, insolation and other pertinent data are provided.

37887 (DOE/R5/10122—2) **Demonstration of an advanced solar garden with a water ceiling. Final technical report, July 1, 1979-June 30, 1980.** Maes, R.; Riseng, C.; Thomas, G.; Mandeville, M. (Environmental Research Inst. of Michigan, Ann Arbor (USA)). Sep 1980. Contract FG02-79R510122. 77p. NTIS, PC A05/MF A01.

A history of the solar garden with the addition of the transparent water ceiling is presented, and a statement of the overall goals of the program is given. The objectives of the water ceiling grant are detailed. The rationale of the transparent water ceiling is developed and its implementation in the solar garden is described. The experimental procedures for evaluating the water ceiling as an integral part of an ongoing garden agricultural experiment are discussed and the results presented. The water ceiling has proven useful in providing extra thermal capacity to the solar garden. It provides heat at night after the water has been warmed during the day and retards overheating in the daytime by absorbing infrared energy into the water. In growing non-flowering plants, such as lettuce and Chinese cabbage, the water ceiling showed no noticeable degradation in yield or maturation rate. In flowering plants, such as tomatoes, the reduced light levels delayed yields by a couple of weeks but the total yield was only slightly diminished. In geographic areas where there is less cloud cover than in Michigan the water ceiling could be much more effective.

37888 (LA-UR— 80-2633) **Applications of DOE-2 for the analysis of passive solar buildings.** Hunn, B.D. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 5p. (CONF-800972—3). NTIS, PC A02/MF A01.

From 1980 Department of Energy passive and hybird solar energy program update meeting; Washington, DC, USA (21 Sep 1980).

The overall objective of this project is to develop passive solar design and analysis tools for commercial buildings. There are two specific objectives: to develop passive solar/large thermal mass simulation capabilities in the DOE-2 building energy analysis computer program so that such systems can be analyzed in commercial building applications; and to perform case studies using DOE-2 to assess the applicability of existing design and analysis tools for passive solar applications in commercial buildings. Progress is summarized. (WHK)

37889 (PNL—3200) **Residential heating costs: a comparison of geothermal, solar and conventional resources.** Bloomster, C.H.; Garrett-Price, B.A.; Fassbender, L.L. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Aug 1980. Contract AC06-76RL01830. 202p. NTIS, PC A10/MF A01.

The costs of residential heating throughout the United States using conventional, solar, and geothermal energy were determined under current and projected conditions. These costs are very sensitive to location - being dependent on the local prices of conventional energy supplies, local solar insolation, cimate, and the proximity and temperature of potential geothermal resources. The sharp price increases in imported fuels during 1979 and the planned decontrol of domestic oil and natural gas prices have set the stage for geothermal and solar market penetration in the 1980's.

37890 (SOLAR/2011—80/14) **Terrell E. Moseley, Inc., Lynchburg, Virginia, solar energy system performance evaluation, October 1979-April 1980.** Kendall, P. (Automation Industries, Inc., Silver Spring, MD (USA). Vitro Labs. Div.). 1980. Contract AC01-79CS30027. 88p. NTIS, PC A05/MF A01.

The Terrell E. Moseley solar energy system supplied 74% of the space heating load required for this single story office building during the heating season of October 1979 through April 1980. The overall thermal performance of the solar heating system was slightly above expected, based on predicted values generated by a modified f-Chart program. The performance measured by solar fraction approximately doubled over that of the previous heating season. (MHR)

37891 (SOLAR/2018—80/14) **Reedy Creek Utilities, Lake Buena Vista, Florida, solar energy system performance evaluation, December 1979-March 1980.** Logee, T. (Automation Industries, Inc., Silver Spring, MD (USA). Vitro Labs. Div.). 1980. Contract AC01-79CS30027. 83p. NTIS, PC A05/MF A01.

The Reedy Creek solar system operated moderately well during the December 1979 through March 1980 heating season. The overall performance of the system was below estimated design performance but the solar system still supplied 47% of the building conditioning loads. The thermal performance is summarized. The system failed to reach design performance levels in the cooling subsystem. Since the cooling load of 40.24 million Btu was nearly three times larger than the space heating and domestic hot water loads of 14.44 million Btu, the overall system performance was significantly reduced. Although collected solar energy exceeds the system load in most months, the solar fraction is necessarily less than 100% due to the normal operating inefficiencies of pumps, heat exchanger, and particularly the absorption chiller. At Reedy Creek, excessive storage losses, presumably due to high storage temperatures, further degrade system performance. Collector array efficiency based on the total incident solar radiation was 11%. This was significantly lower than the 14% collector array efficiency for the 1979 heating season.

37892 (SOLAR/2036—80/14) **Solar energy system performance evaluation: Page Jackson Elementary School, Charles Town, West Virginia, October 1979-April 1980.** Howard, R.G. (Automation Industries, Inc., Silver Spring, MD (USA). Vitro Labs. Div.). 1980. Contract AC01-79CS30027. 74p. NTIS, PC A04/MF A01.

This school in Charles Town, West Virginia is equipped with 11,215 ft^2 of PPG flat-plate collectors of which 69% operate. Two insulated tanks of 10,000 gal capacity provide heat storage. A natural gas fired boiler and a chiller augment the solar heating and cooling system. Collector failure was primarily responsible for the system supplying 23% rather than the projected 85% of the heating requirement. (MHR)

37893 (SOLAR/2066—80/14) **Solar energy system performance evaluation: Billings Shipping, Billings, Montana, October 1979-April 1980.** Evans, K.D. (Automation Industries, Inc., Silver Spring, MD (USA). Vitro Labs. Div.). 1980. Contract AC01-79CS30027. 77p. NTIS, PC A05/MF A01.

The Billings Shipping site is an enclosed freight distribution facility with 4900 square feet of heated office space. The solar energy system consists of an array of 1968 square feet of flat-plate, liquid (glycol, 50/50 Dowtherm) collectors made by Lennox Industries. The collectors face 10 degrees east of south and solar energy is delivered to a 2500-gallon steel tank, buried five feet underground. Auxiliary energy is supplied by a gas-fired hot water boiler. The Billings Shipping solar energy system supplied 24% of the space heating requirements for this office building during the season of October 1979 through April 1980. The energy supplied (24%) is significantly lower than the estimated design contribution (54%) for the solar energy system, but is closer to the prediction of the f-Chart model (38%). The design goal appears to be obtainable only during the most temperate winter months.

37894 **Stochastic predictions of solar cooling system performance.** Anand, D.K.; Deif, I.N.; Bazques, E.O.; Allen, R.W. (Univ of Md, College Park). *Trans. ASME;* **102**: No. 1, 47-54(Feb 1980).

The use of computerized system simulations for sizing and performance predictions of various solar systems requires some form of weather input to act as a system stimulus. One such method employs a probabilistic approach. This work uses the stochastic (probabilistic) method to produce representative weather for five geographic regions in the U.S. for the summer months. Parallel runs are conducted with real and stochastic weather. 3 refs.

37895 (SOLAR/2033—80/14) **Solar energy system performance evaluation, November 1979-April 1980: Telex communications, Blue Earth, MN.** Raymond, M.G. (Automation Industries, Inc., Silver Spring, MD (USA). Vitro Labs. Div.). [nd]. Contract AC01-79CS30027. 88p. NTIS, PC A05/MF A01.

The Telex solar energy system supplied 82% of the space heating required for this building during the heating season of November 1979 through April 1980. The overall performance of the solar system was equal to expectations during this season. The design solar fraction is from 70 to 79 percent of the total heating requirement for the entire heating season, which would include October in addition to the months reported here, November through April. (No data is available for October 1979.) The measured solar fraction for November through April was 82%. The solar fraction should have been 100% in October (the load in October is smaller than in November, which had a 100% solar fraction), so, including October, the seasonal solar fraction should have been greater than 82%. The solar fraction is higher than the design value because the solar system performed as well as it was designed to, and the heating load was significantly smaller than the design load. There are two reasons for the reduced heating load. First, the winter was warmer than normal. There were 6,812 heating degree-days in November through April, compared to the long-term average of 7,131. Second, more conservation was practiced this year than was allowed for in the design. The building temperature was allowed to fall to 60°F at nights and on weekends. Some parts of the building were reportedly at lower temperatures than this at times, but there is only one building temperature sensor at the Telex factory, so a detailed accounting of the building temperature cannot be given. The thermal performance is summarized. The actual (measured) performance of the solar system is compared with f-Chart predictions of the performance, based on the manufacturer's collector performance data, and measured weather, loads and losses.

AGRICULTURAL AND INDUSTRIAL PROCESS HEAT

REFER ALSO TO CITATION(S) 37615, 37886

37896 (SERI/TR—98326-1) **Calcium carbide production in a solar furnace. Final report.** Duncan, D.A.; Dirksen, H.A. (Institute of Gas Technology, Chicago, IL (USA)). Jul 1980. Contract AC02-77CH00178. 80p. NTIS, PC A05/MF A01.

The technical feasibility of making calcium carbide from lime and coke using solar heat was documented in a series of experimental runs conducted at the Odeillo (France) laboratory of the Centre National de la Recherche Scientifique (CNRS), wherein 30 to 40% of the lime-coke mixture was converted to carbide by rapid heating of the reactant mixture in an open, water-cooled crucible. The solidified carbide melt was easily separated from the unreacted lime-coke mixture and generated acetylene when added to water. The amount of carbide formed was calculated by measuring the acetylene produced with a gas burette. The experiments were necessarily on a small scale because of the size of the focal area of the 2-kW furnace and typically involved about 1 gram of lime-coke mixture. The practicability of making carbide using solar heat was nonetheless established. The carbon monoxide produced at the same time as the carbide, and the acetylene released from the carbide, are important building blocks for fuels and petrochemicals.

WATER HEATING

REFER ALSO TO CITATION(S) 37893

37897 (DOE/CS/10577—T1) **Recycled used fluorescent light tube solar water heater. Final technical report.** Jaquette, F.M. (Jaquette (Frank M.), Mangilao, GU). 1979. Contract FG03-79SF10577. 24p. NTIS, PC A02/MF A01.

A project to investigate methods that might be used to utilize old fluorescent light tubes as solar water heater components then to produce a booklet of instructions for others to use to construct their

own water heaters is described. Various methods of opening, cleaning and shaping the ends of the tubes were attempted. The reflective material needed inside some of the heaters was mylar and worked quite well but the Btu gain was disappointing. There were problems with the cement used and epoxy resin was finally used. Two types of collectors using reflectors also used temperature differential thermostats and small pumps. One thermosyphon model used no reflectors nor tube length copper pipe; it produced more Btu's per day than either motorized model. Preliminary test data are included. It was found that for Guam at least, the reflector type collectors I developed would not produce hot enough water for absorption type refrigeration.

MISCELLANEOUS SOLAR APPLICATIONS

37898 (PB—80-804107) **Solar furnaces (citations from the Engineering Index data base). Report for 1970-Jan 80.** Hundemann, A.S. (National Technical Information Service, Springfield, VA (USA)). Feb 1980. 60p. NTIS PC N01/MF N01.

Design, operation, and performance of solar furnaces are discussed in abstracts from worldwide literature. Topic areas include the thermodynamics and optics of operation, and the performance of the large solar furnace located at Odeillo (France). (This updated bibliography contains 53 abstracts, 7 of which are new entries to the previous edition.)

SOLAR COLLECTORS AND CONCENTRATORS

REFER ALSO TO CITATION(S) 37813, 37897

37899 (CONF-790442—20) **CVD molybdenum films of high infrared reflectance.** Carver, G.E. (Arizona Univ., Tucson (USA). Optical Sciences Center). 1979. Contract AS04-76ET20247. 14p. NTIS, PC A02/MF A01.

From International conference on metallurgical coatings; San Diego, CA, USA (23 Apr 1979).

Molybdenum thin films of high infrared reflectance have been deposited by pyrolytic decomposition of molybdenum carbonyl ($Mo(CO)_6$), and by hydrogen reduction of molybdenum pentachloride ($MoCl_5$). Reflectance values within 0.7% of the reflectance of supersmooth bulk molybdenum have been attained by annealing films of lower reflectance in both reducing and non-reducing atmospheres. All depositions and anneals proceed at atmospheric pressure, facilitating a continuous, flow-through fabrication. These reflectors combine the high temperature stability of molybdenum thin films with the infrared reflectance of a material such as aluminum. Deposition from $Mo(CO)_6$ under oxidizing conditions, and subsequent anneal in a reducing atmosphere, results in films that combine high solar absorptance with low thermal emittance. If anti-reflected, black molybdenum films can serve as highly selective single layer photothermal converters. Structural, compositional, and crystallographic properties have been measured after both deposition and anneal.

37900 (DOE/CS/30171—2) **Development of a low-cost black-liquid solar collector, Phase II. Second semi-annual report, March 1, 1980-August 31, 1980.** Landstrom, D.K.; Talbert, S.G.; McGinniss, V.D. (Battelle Columbus Labs., OH (USA)). 30 Sep 1980. Contract AC04-79CS30171. 15p. NTIS, PC A02/MF A01.

Battelle's Columbus Laboratories (BCL) is continuing its research effort to develop an efficient, low-temperature, low-cost, flat-plate black-liquid solar collector. The research efforts during this second 6-month period of Phase II have been directed toward (1) evaluating the long-term durability of various plastic materials and solar collector designs, (2) obtaining sufficient outdoor performance data to design a full-scale demonstration of a black-liquid solar collector for a commercial application, (3) working closely with a company willing to commercialize black liquid plastic collectors, and (4) incorporating improved black liquids with the identified plastic collector designs. Besides conducting indoor weathering tests of various plastic materials, two outdoor automated test facilities have been operated. One unit has been in use since February 1980 at Battelle in Columbus, Ohio, and the other unit began operation in May 1980 at Ramada Energy Systems, Inc., a collector manufacturing company near Phoenix, Arizona. Since Ramada Energy Systems has been working with extruded polycarbonate panels, Battelle has been working to date with extruded acrylic panel designs. Other potential plastics for solar collectors are being evaluated by exposure testing.

37901 (DOE/CS/34287—T1) **Solar-selective paint coating development. Final report.** McKelvey, W.D.; Zimmer, P.B.; Lin, R.J.H. (Honeywell, Inc., Minneapolis, MN (USA)). Dec 1979. Contract AC04-78CS34287. 83p. NTIS, PC A05/MF A01.

Formulations and process conditions for thickness-sensitive paint coatings were defined. New pigments were evaluated, but none were found which can be used as a substitute for Ferro's F-6331. Coating thermal stability, weathering and humidity resistance, and effects of pigment agglomeration size on coating optical performance were studied. Eighteen hundred square feet of aluminum foil were coated in the first large-scale application with optical properties of α/sub s/ = 0.90 and ϵ = 0.25. This demonstrated that a high-speed laminator is capable of producing a coating with uniform optical properties by a roll coating technique. Thickness-insensitive paint coatings were developed with urethane, acrylic, and silicone binders. This type of coating combines the selective coatings currently under development and aluminum flake to provide the low emittance substrate. By varying the ratio of paint to flake, selective properties of α/sub s/ = 0.90 and ϵ = 0.31 were achieved. The silicone systems showed the best optical performance. Aluminum powder which gave larger surface area was evaluated and found not feasible. Washing and aging techniques of the aluminum flake were studied in an attempt to improve optical performance. (MHR)

37902 (DOE/ER/05003—T1) **Graded index antireflective coatings for glass. Second annual report.** Haggerty, J.S. (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). May 1980. Contract AS02-78ER05003. 23p. NTIS, PC A02/MF A01.

M.I.T. is conducting research which will lead to a process for forming broad band antireflective (AR) coatings on glass. Use of these coatings increases the extractable heat from flat-plate solar collectors by 30 to 50% compared with their performance under equivalent solar flux, surface temperature and ambient conditions without broad band AR coatings. Graded index surface films can virtually eliminate reflection losses if controlled properly. Graded index films on a borosilicate glass (Corning Glass Works No. 7740, Pyrex) has been demonstrated. While glass treated this way exhibited adequate optical properties, the glass itself, cannot be fabricated by the float glass process because of excessive working temperatures, and consequently is too expensive for solar applications. The objective of this work is to define glass compositions and processing steps which will result in graded index surface films (which exhibit broad band AR characteristics) on glasses which can be fabricated by the float glass process. The mechanism by which these graded index surface films are produced on glass surfaces consists of preferentially etching one phase from a phase separated glass. The film which remains consists of a porous structure in which the fraction of solid phase increases continuously from the free surface toward the bulk glass. Scattering effects are eliminated by limiting the size of the pore structure to dimensions which are substantially less than the wavelength of light. With this structure, the local index of refraction is proportional to the fraction of solid phase which is present. Characterizations are intended to define the microstructural and chemical nature of the surface film throughout its thickness. Progress is reported. (WHK)

37903 (MLM—2770(OP)) **Salt-gradient solar ponds: design, construction and power production.** Wittenberg, L.J. (Mound Facility, Miamisburg, OH (USA)). 1980. Contract AC04-76DP00053. 19p. (CONF-800871—1). NTIS, PC A02/MF A01.

From International symposium on solar energy utilization; London, Ontario, Canada (10 Aug 1980).

Salt-gradient solar ponds are combined solar energy collectors and thermal storage systems. The ponds are made non-convective by the formation of a density-gradient composed of salt solutions whose concentrations increase with depth. The depth of the various layers of the pond determine the efficiency and thermal storage capacity of the system. The construction of the largest such pond in the US, 2000 m^2, was completed in 1978 for approximately \$35/m^2. The pond is estimated to produce 1015 GJ/y of low-temperature heat at a cost of \$8.95/GJ, when the installation costs are amortized over 15 y. Construction changes are suggested to improve the reliability of the system. Electrical power generation by the use of Rankine cycle turbogenerators connected to solar ponds has been demonstrated in Israel. Feasibility studies are in progress to propose electricity production of up to 2000 MW for projects near the Dead Sea in Israel, and 600 MW in a proposed project at the California Salton Sea.

37904 (PNL—3327) **ETRANS: an energy transport system optimization code for distributed networks of solar collectors.** Barnhart, J.S. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Sep 1980. Contract AC06-76RL01830. 48p. NTIS, PC A03/MF A01.

The optimization code ETRANS was developed at the Pacific Northwest Laboratory to design and estimate the costs associated with energy transport systems for distributed fields of solar collectors. The code uses frequently cited layouts for dish and trough collectors and optimizes them on a section-by-section basis. The optimal section design is that combination of pipe diameter and insulation thickness that yields the minimum annualized system-resultant cost. Among the quantities included in the costing algorithm are (1) labor and materials costs associated with initial plant construction, (2) operating experses due to daytime and nighttime heat losses, and (3) operating expenses due to pumping power requirements. Two preliminary series of simulations were conducted to exercise the code. The results indicate that transport system costs

for both dish and trough collector fields increase with field size and receiver exit temperature. Furthermore, dish collector transport systems were found to be much more expensive to build and operate than trough transport systems. ETRANS itself is stable and fast-running and shows promise of being a highly effective tool for the analysis of distributed solar thermal systems.

37905 (SAND—80-0808) **Protective coatings and sealants for solar applications.** Wischmann, K.B.; Gonzales, M.H. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1980. Contract AC04-76DP00789. 46p. NTIS, PC A03/MF A01.

An aging study has been completed which evaluated a number of polymeric materials for potential use as (1) protective coatings for back surfaces of mirrors and (2) solar heliostat edge seals. These investigations were conducted in an artificial weathering chamber that accelerated thermal cycling. The primary mirror failure mode was observed to be silver corrosion resulting from moisture exposure. To increase mirror longevity in current heliostat designs, intimate bonding at all the composite interfaces is essential to minimize moisture pathways to the silvered surface. If any voids or delaminations are present, mirror degradation will eventually occur. Delaminations can also occur as the result of mechanical stresses brought about by mismatches in the various materials coefficients of thermal expansion. If good bonding cannot be achieved or mechanical stresses avoided, then improved moisture barriers must be designed to assure mirror longevity. With good adhesion, a KRATON rubber was found to exhibit superior back surface mirror protection (12 months in environmental chamber with no corrosion). An ultraviolet stabilized butyl rubber appeared to be the best edge seal. All heliostats edge sealed with silicones showed silver corrosion which indicated either poor bonding or moisture permeation.

37906 (SAND—80-7003) **Material and process screening as applied to a reinforced plastic parabolic trough concentrator module.** Hodge, R. (ed.). (General Electric Co., Philadelphia, PA (USA). Valley Forge Space Center). Aug 1980. Contract AC04-76DP00789. 77p. NTIS, PC A05/MF A01.

Existing parabolic trough solar collectors are basically sheet metal designs utilizing aluminum or steel as the major structural materials. The relatively high labor content associated with these sheet metal designs has generated an interest in investigating the cost effectiveness of using reinforced plastics as a major structural material for trough solar collectors. This interest is bolstered by a growing desire on the part of industry to identify new material-process combinations which save weight, use less energy, and require less capital equipment and assembly costs. The use of reinforced plastics as the basic material for a line-focus parabolic trough concentrator module is studied. This module constitutes a basic building block with which longer trough rows can be built. The basic part analysis is described including the quantification of key material and part-function relationships. In addition candidate materials and processes are reviewed and, the costs associated with the most attractive combinations defined. Finally, the major conclusions and recommendations are summarized.

37907 (SAND—80-8032) **Status and recommended future of plastic-enclosed heliostat development.** Mavis, C.L. (Sandia National Labs., Livermore, CA (USA)). Oct 1980. Contract AC04-76DP00789. 56p. NTIS, PC A04/MF A01.

Tests have shown that biaxially oriented Kynar film has excellent weathering properties as an enclosure material and is practical to manufacture commercially. Reflectors using Kynar or weatherized polyester also appear to be feasible. The projected low cost of properly designed plastic-enclosed heliostats indicates that further development effort should be continued. Both Boeing's one-piece enclosure and General Electric's multi-piece enclosure concept should be pursued. Full-size enclosures and reflectors need to be fabricated and set up at several desert locations to verify the designs and obtain weathering data under actual use conditions.

37908 (SERI/TP—351-540(Rev.)) **Solar collector systems analysis using infrared scanning techniques.** Eden, A. (Solar Energy Research Inst., Golden, CO (USA)). Aug 1980. Contract AC02-77CH00178. 21p. (CONF-800958—1(Rev.)). NTIS, PC A02/MF A01.

From Conference of themal infrared sensing applied to energy conservation in building envelopes (thermo sense III); Minneapolis, MN, USA (2 Sep 1980).

Solar energy collector systems analysis using thermography is discussed. The research at the Solar Energy Research Institute (SERI) in this area has focused on infrared (IR) scanning techniques and equipment to determine temperature distributions, flow patterns, and air blockages in solar collectors. The results of this extensive study, covering many sites and types of collectors, illustrate the capabilities of IR analysis as an analysis tool and operation and maintenance procedure when applied to large arrays. Infrared analysis of most collector systems showed temperature distributions that indicated balanced flow patterns with both the thermographs and the hand-held unit. In three significant cases, blocked or broken collector arrays, which previously had gone undetected, were discovered. Using this analysis, validation studies of large computer codes could examine collector arrays for flow patterns or blockages that could cause disagreement between actual and predicted performance. Initial operation and balancing of large systems could be accomplished without complicated sensor systems not needed for normal operations. Maintenance personnel could quickly check their systems without climbing onto the roof and without complicated sensor systems.

37909 **Refinement of solar absorbing black chrome microstructure and its relationship to optical degradation mechanisms.** Zajac, G.; Smith, G.B.; Ignatiev, A. (Department of Physics, University of Houston, Houston, Texas 77004). *J. Appl. Phys.*; **51**: No. 10, 5544-5554(Oct 1980).

An in depth characterization of the electrodeposited solar absorber black chrome resulting in refinement of the microstructural model of the coating is presented in light of current studies in valence band Auger electron spectroscopy, x-ray photoelectron spectroscopy, thermal desorption spectroscopy, secondary ion mass spectroscopy, and the chromium electrodeposition mechanism. Through the presented model, the structural and chemical parameters of the coating are linked to its optical response with the degradation of the optical response at elevated temperatures related to changes in these parameters. The degradation process is divided into two distinct phases. First, upon heating to low temperatures ($<$ or $\approx$300 °C) the chromium hydroxide localized on the surface and within the microstructure of the film decomposes producing H_2O and chromium oxide leaving an expected microvoid-metallic particle structure. Heating to temperatures in excess of 300 °C leads to the second degradation phase. The fine chromium crystallites comprising the film undergo oxidation and the metallic chromium component, responsible for the intrinsic optical absorption, is diminished. The optical model of the solar absorbing film has been refined within the effective medium approach to account for the flat response in the visible part of the spectrum.

HEAT STORAGE

REFER ALSO TO CITATION(S) 37903

GEOTHERMAL ENERGY

GEOTHERMAL ENERGY

37910 (DOE/ET/27196—T1) **Largest irrigated district in the world.** (Imperial, County of, El Centro, CA (USA). Dept. of Public Works). 2 Oct 1980. Contract FC03-79ET27196. 46p. NTIS, PC A03/MF A01.

The geothermal administration report includes the following: status of transfer of Imperial Valley Environmental Project, status of data cataloging and storage, findings of geothermal field inspections, status of cooperative efforts between industry and the County for commercialization, problems in local geothermal commercialization and recommendations for action, and the status of geothermal exploration development and production in the County. The number and types of applications for geothermal energy received, results of hearings on applications, permits issued, and EIR prepared are discussed. Other geothermal activities include the Department of Energy Region 9 meeting in April, the Department of Energy Direct Heat Developers meeting held in El Centro in April, and a new drilling company in the County. These are followed by the summary of events. (MHR)

RESOURCE STATUS AND ASSESSMENT

REFER ALSO TO CITATION(S) 38038

37911 (PB—80-134430) **Geothermal energy: obstacles and uncertainties impede its widespread use. Report to the Congress.** (General Accounting Office, Washington, DC (USA). Energy and Minerals Div.). 18 Jan 1980. 51p. NTIS, PC A04/MF A01.

This report discusses the obstacles and uncertainties impeding the widespread use of geothermal energy. It includes a perspective on geothermal energy's development and potential, and a discussion of Federal actions needed to help accelerate geothermal development and use.

USA

REFER ALSO TO CITATION(S) 37924

37912 (DOE/ID/12019—2) **Nevada geothermal commercialization program. Geothermal area development plan: resource Area 4, Carson City; resource Area 1, Washoe County.** Pugsley, M. (Nevada Dept. of Energy, Carson City (USA)). Sep 1980. Contract FC07-79ID12019. 157p. NTIS, PC A08/MF A01.

Separate abstracts were prepared for the two papers included in this report. (MHR)

37913 (DOE/ID/12019—2, pp 61p, Paper 1) **Geothermal resource Area 4, Carson City. Area development plan.** Pugsley, M. (Nevada Department of Energy, Carson City). Sep 1980.

In Nevada geothermal commercialization program. Geothermal area development plan: resource Area 4, Carson City; resource Area 1, Washoe County.

Geothermal Resource Area 4 includes all of the land in Carbon City, Nevada. Within this area are three known geothermal anomalies: Carson Hot Springs, Prison Hot Springs, and Pinyon Hills. After evaluating the physical characteristics of the Carson City area, the various land ownership and zoning patterns, existing population and projected growth rates, transportation facilities, energy use by the residents, businesses, and industries of Carson City in relationship to the physical characteristics of the geothermal resource itself the potential uses of each resource are listed. The geothermal resource in Carson City is somewhat limited in its development potential. (MHR)

37914 (DOE/ID/12019—2, pp 90p, Paper 3) **Geothermal resource Area 1. Area development plan.** Pugsley, M. (Nevada Department of Energy, Carson City). Sep 1980.

In Nevada geothermal commercialization program. Geothermal area development plan: resource Area 4, Carson City; resource Area 1, Washoe County.

Geothermal Resource Area 1 includes all of the land in Washoe County, Nevada. Within this area are six major geothermal anomolies: Steamboat Hot Springs, Moana Hot Springs, the Needles Rocks, Gerlach Hot Springs, Ward's Hot Springs, and the San Emidio Desert Hot Springs. Various feasible uses of the energy found at each of the resource sites were determined after evaluating the characteritics of Washoe County. This evaluation included the physical characteristics, the land ownership pattern, existing population and projected growth rates, transportation facilities, and energy use by the residents, businesses, and industries of Washoe County in relationship to the geothermal resource itself. The uses considered were divided into 12 major categories; individual, district, and industrial space heating; low, medium, and high industrial process heat; hot water for various uses; agricultural production; greenhousing; aquaculture; recreation; and electrical generation. Potential uses of the geothermal resources of Washoe County are listed.

37915 (UT/CES-CP—10(Vol.1), pp 219-234) **Perspectives on geopressured resources within the geothermal program.** DiBona, B. (Dep. of Energy, Washington, D.C.). Jun 1980.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

The potential of geothermal energy in the United States is reviewed. Current sources of and uses for geothermal energy are described. The way geopressured resources fit into the geothermal program of the Department of Energy (DOE) is outlined. Description of the program status includes progress in drilling and assessing geopressured resources.

37916 (UT/CES-CP—10(Vol.3), pp 1087-1136) **Distribution of geopressured-geothermal energy in reservoir fluids of the northern Gulf of Mexico basin.** Wallace, R.H. Jr. (Geological Survey, Bay St. Louis, MS). Jun 1980.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

An estimated 17,100 quintillion (10^{18}) joules of thermal and thermal-equivalent methane energy comprises the resource base (energy in place) in reservoir fluids in sandstone underlying a 120,000 square mile (310,000 square kilometer) area of the northern Gulf of Mexico basin. Almost 50 percent of this energy occurs beneath the Federal Outer Continental Shelf (OCS) area, 24 percent or less beneath Louisiana, and the remainder beneath Texas. In 44 areas, a thermal energy content of 60 quadrillion (10^{15}) joules per square kilometer or more occurs below the depth of occurrence of geopressure to a depth of 22,500 feet (6.86 kilometers) below mean sea level. Dissolved methane content exceeds 30 billion (10^{9}) standard cubic feet per square kilometer in 29 areas. Most of these areas are located within about six trends of high energy concentration that occur outside the areas of shallowest occurrence of geopressure.

37917 (UT/CES-CP—10(Vol.3), pp 1484-1498) **Description of the technoeconomical model used to analyze the development potential of Louisiana geopressured energy prospects.** Wrighton, F.M.; Johnson, A.E. Jr. (Louisiana State Univ., Baton Rouge). Jun 1980.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

A description and explanation of the technoeconomic simulation model used in the analysis of the commercial potential of geopressure/geothermal prospects in Louisiana is provided. This model has been developed and refined over the last year by members of the LSU Operations Research team in conjunction with the analysis of geopressure/geothermal resources in Louisiana. This interdisciplinary development has produced a comprehensive model that provides substantial flexibility for the user to explore different alternatives in the the simulation of a specific prospect. In addition to this feature, the model also incorporates an optimization subroutine that will solve for the optimum value of a specified parameter, either technical or economic, that would make a given prospect commercially viable. Although the model has been used predominately as a deterministic simulator, there is provision for probabilistic solutions.

37918 **Keynote address: achieving the delicate but essential balance.** Liverman, J.L. pp 90-96 of Geothermal environmental seminar-'78. Tucker, F.L.; Tanner, L.R. (eds.). Clearlake Oaks, CA; Lake County Printing (1978).

From Geothermal seminar; Sacramento, CA, USA (9 May 1978).

The following topics are discussed: the balanced development of geothermal resources in an environmentally acceptable manner, the significant role seen for geothermal energy as part of the total national energy picture, and California as a major resource for geothermal power and as a model for geothermal development in the rest of the country. (MHR)

GEOLOGY AND HYDROLOGY OF GEOTHERMAL SYSTEMS

REFER ALSO TO CITATION(S) 37930, 37932, 37982

37919 (UT/CES-CP—10(Vol.2), pp 907-932) **Analysis of reservoir mechanics of geopressured geothermal aquifers - The Brazoria County prospect.** Ohkuma, H. (Univ. of Texas, Austin); Sepehrnoori, K.; Lewis, J. T.; Knapp, R.M.; MacDonald, R.C. Jun 1980.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

Aquifers of abnormally high pressures, known as geopressured goethermal aquifers, are found extensively in the Gulf Coast region of the United States. The hot water contained in the aquifers may have a significant amount of dissolved hydrocarbon gas. A two-phase, two-dimensional simulator using a finite difference technique was developed for simulating the production behavior of these geopressured aquifers. A series of cross-sectional model calculations were performed to analyze reservoir mechanics operative in a geopressured aquifer. Investigated are the effects of reservoir heterogeneities and completion strategies on resource recovery. Finally, an assessment is made of the effects of gas evolution about the wellbore on well productivity.

37920 (UT/CES-CP—10(Vol.2), pp 933-959) **Geopressured aquifer simulator.** Byrnes, A.P.; Rockar, E.M.; Randolph, P.L.; Kelkar, S.M. (Inst. of Gas Tech., Chicago, IL). Jun 1980.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

Ten natural gas companies have funded the Institute of Gas Technology (IGT) development of a laboratory facility for fluid and core analyses at temperatures and pressures characteristic of geopressured aquifers. The facility has been designed and constructed to measure the following parameters at pressures up to 20,000 psi and temperatures to 450°F: solubility of methane in brines from actual geopressured aquifers; dependence of compression and compaction reservoir drive upon pressure; dependence of permeability upon reservoir pressure and temperatures; and dependence of relative permeabilities to gas and to water upon the water saturation of pores, pressure, and temperature. The temperatures, pressures, differential pressure, and flow rates are controlled and/or recorded by a digital microcomputer/microprocessor. Operation will be controlled from a separate room and programmed; hands-off operation will be the normal mode of operation. The facility has been constructed and is now being tested. Following performance testing with Berea sandstone, initial emphasis will be upon studies of brine and available core from DOE's Pleasant Bayou No. 1 and No. 2 wells.

37921 (UT/CES-CP—10(Vol.2), pp 960-971) **Estimation of stress-sensitive reservoirs' initial parameters by use of the conventional well test methods.** Elemo, R.O. (Univ. of Ibadan, Nigeria); Knapp, R.M. Jun 1980.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

The results of the study made to estimate the initial values of some pertinent parameters for stress-sensitive reservoirs by using current conventional well test methods are discussed. Stress-sensitive

reservoirs possess rock and fluid properties that change as the effective stress on the reservoir rock changes. As a result of some of the assumptions made to develop the conventional well test methods, such methods may not be suitable for stress-sensitive reservoir parameter estimation. This study was made to determine the degree of discrepancy that can be expected if the conventional well test methods are applied. A hypothetical, stress-sensitive geopressured-geothermal closed square reservoir flowing a single phase, slightly compressible fluid was selected for the investigation. The parameter determined is the initial formation permeability. Pressure drawdown, pressure buildup, and multiple flow rate tests were simulated for the purpose of the estimation. A two-dimensional finite difference model of the reservoir was used. The results obtained by use of these conventional well test methods are poor. Actual data from a geopressured-geothermal reservoir will be required to confirm the validity of the model.

37922 (UT/CES-CP—10(Vol.2), pp 1031-1059) **Deformation behavior of rocks from the Pleasant Bayou wells.** Gray, K.E.; Jogi, P.N.; Morita, N.; Thompson, T.W. (Univ. of Texas, Austin). Jun 1980.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

Tests have been run on cores retrieved from DOE-GOC Pleasant Bayou wells # 1 and # 2. These have included uniaxial compaction and triaxial loading tests (both jacketed and unjacketed). In each series of tests, deformation behavior, pore volume changes, permeabilities, and acoustic velocities have been measured. All of the tests reported have been carried out under rapid loading conditions and analyzed on the basis of pseudoelastic behavior. In addition to providing numerical data, the tests show that in many cases the rocks are significantly nonelastic and that dynamic data show little relationship to static data. The values for compressibilities obtained from these tests are considerably lower than those used in some earlier production models.

37923 **Dynamics of steam producing geothermal reservoirs.** Weres, O. (Lawrence Berkeley Lab., CA). pp 189-195 of Geothermal environmental seminar-'78. Tucker, F.L.; Tanner, L.R. (eds.). Clearlake Oaks, CA; Lake County Printing (1978).

From Geothermal seminar; Sacramento, CA, USA (9 May 1978).

The current thinking and research on the origin and dynamics of steam producing reservoirs are summarized. The Larderello and The Geysers reservoirs are discussed. (MHR)

USA

REFER ALSO TO CITATION(S) 37936, 37938, 37947, 37951, 37957, 37971, 38045

37924 (SAND—80-1671) **Comparative assessment of five potential sites for hydrothermal-magma systems: energy transport.** Hardee, H.C. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1980. Contract AC04-76DP00789. 18p. NTIS, PC A02/MF A01.

A comparative assessment of five sites is being prepared as part of a Continental Scientific Drilling Program (CSDP) review of thermal regimes for the purpose of scoping areas for future research and drilling activities. This background report: discusses the various energy transport processes likely to be encountered in a hydrothermal-magma system, reviews related literature, discusses research and field data needs, and reviews the sites from an energy transport viewpoint. At least three major zones exist in the magma-hydrothermal transport system: the magma zone, the hydrothermal zone, and the transition zone between the two. Major energy transport questions relate to the nature and existence of these zones and their evolution with time. Additional energy transport questions are concerned with the possible existence of critical state and super-critical state permeable convection in deep geothermal systems. A review of thermal transport models emphasizes the fact that present transport models and computational techniques far outweigh the scarcity and quality of deep field data.

37925 (UT/CES-CP—10(Vol.1), pp 373-413) **Analysis of Texas Gulf Coast Tertiary sandstones to delineate areas of high-quality geopressured geothermal reservoirs.** Loucks, R.G.; Dodge, M.M. (Univ. of Texas, Austin). Jun 1980.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

Analysis of reservoir quality of lower Tertiary sandstones along the Texas Gulf Coast delineates areas most favorable for geopressured geothermal exploration. Reservoir quality is determined by whole core and petrographic analyses. Wilcox sandstones exhibit no regional reservoir quality trends. In Lower and in parts of Middle and Upper Texas Gulf Coast they show a reversal toward increased porosity at depth. The Wilcox Group has good reservoir potential for geopressured geothermal energy in the Middle Texas Gulf Coast and possibly in adjacent areas, but other Wilcox areas are marginal. Vicksburg sandstones have the poorest reservoir quality of sandstones of any formation and are not prospective for geothermal energy. Reservoir quality in the Frio Formation increases from very poor in lowermost Texas, to marginal into the Middle Texas Gulf Coast and to good through the Upper Texas Gulf Coast. This increase in reservoir quality correlates to changes in rock composition and cementation. The Frio Formation in the Upper Texas Gulf Coast has the best deep-reservoir quality of any unit along the Texas Gulf Coast.

37926 (UT/CES-CP—10(Vol.3), pp 1160-1199) **Subsurface and seismic investigation of the geopressured-geothermal potential of south Louisiana. Part I. The Abbeville area.** Paine, W.R.; Kinsland, G.L.; Duhon, M.P.; Dungan, J.R. (Univ. of Southwestern Louisiana, Lafayette,). Jun 1980.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

The structure investigated is a basin which is roughly bounded by the Abbeville Dome on the west, the Erath Dome on the southeast, and the Grosse Isle Dome on the northeast and whose center is located at approximately Section 31 T14S R4E. The geopressured sands investigated are below approximately 12,800 ft (3901 m) in the center of the basin and consist of two groups of rather thin, discontinuous, marly sands. These two groups, rather arbitrarily defined, are termed the upper and lower geopressured sands, and the following map types and analyses have been derived from subsurface data of each: structure, temperature, pressure, salinity, and net sand maps; and porosity, permeability, and methane content analyses. Four CDP seismic lines were purchased and reprocessed, and structural maps from four horizons were prepared from them. These maps confirmed that the major faults found over the domes do in fact extend into the basin. The general basin structure and shape are also confirmed, as is the shape of an unconformity surface which appears to mark the top of geopressure in the area. Perhaps the most important result of the seismic data is the proof that the rocks below the unconformity, i.e., in the geopressured region of interest, are highly and complexly faulted.

37927 **Geothermal potential northeast of Clear Lake, California.** Donnelly, J.M.; Goff, F.E.; Nehring, N.L. (Geological Survey, Menlo Park, Ca). pp 345-352 of Geothermal environmental seminar-'78. Tucker, F.L.; Tanner, L.R. (eds.). Clearlake Oaks, CA; Lake County Printing (1978).

From Geothermal seminar; Sacramento, CA, USA (9 May 1978).

The geology and surface manifestations of geothermal energy are described for this 400 km^2 area. Geochemical indicators are discussed. (MHR)

GEOTHERMAL EXPLORATION AND EXPLORATION TECHNOLOGY

37928 (LA—8280-HDR) **Hot Dry Rock Geothermal Energy Development Program. Annual report, fiscal year 1979.** Cremer, G.M.; Duffield, R.B.; Smith, M.C.; Wilson, M.G. (comps.). (Los Alamos Scientific Lab., NM (USA)). Aug 1980. Contract W-7405-ENG-36. 255p. NTIS, PC A12/MF A01.

The Fenton Hill Project is still the principal center for developing methods, equipment, and instrumentation for creating and utilizing HDR geothermal reservoirs. The search for a second site for a similar experimental system in a different geological environment has been intensified, as have the identification and characterization of other HDR areas that may prove suitable for either experimental or commercial development. The Phase I fracture system was enlarged during FY79. Drilling of the injection well of the Phase II system began at Fenton Hill in April 1979. Environmental monitoring of the Fenton Hill area continued through FY79. The environmental studies indicate that the hot dry rock operations have caused no significant environmental impact. Other supporting activities included rock physics, rock mechanics, fracture mapping, and instrumentation development. Two closely related activities - evaluation of the potential HDR energy resource of the US and the selection of a site for development of a second experimental heat-extraction system generally similar to that at Fenton Hill - have resulted in the collection of geology, hydrology, and heat-flow data on some level of field activity in 30 states. The resource-evaluation activity included reconnaissance field studies and a listing and preliminary characterization of US geothermal areas in which HDR energy extraction methods may be applicable. The selection of Site 2 has taken into account such legal, institutional, and economic factors as land ownership and use, proximity to possible users, permitting and licensing requirements and procedures, environmental issues, areal extent of the geothermal area, and visibility to and apparent interest by potential industrial developers.

37929 (UT/CES-CP—10(Vol.1)) **Fourth United States Gulf Coast geopressured-geothermal energy conference: research and devel-**

opment. Dorfman, M.H.; Fisher, W.L. (eds.). (Texas Univ., Austin (USA). Center for Energy Studies). Jun 1980. Contract AC08-79ET27018. 521p. (CONF-7910104—(Vol.1)). NTIS, PC A22/MF A01.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

Thirteen papers are included. Separate abstracts were prepared for each one. (MHR)

37930 (UT/CES-CP—10(Vol.2)) **Fourth United States Gulf Coast geopressured-geothermal energy conference: research and development.** Dorfman, M.H.; Fisher, W.L. (eds.). (Texas Univ., Austin (USA). Center for Energy Studies). Jun 1980. Contract AC08-79ET27018. 567p. (CONF-7910104—(Vol.2)). NTIS, PC A24/MF A01.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

Thirteen papers are included. Separate abstracts were prepared for each one. (MHR)

37931 (UT/CES-CP—10(Vol.3)) **Fourth United States Gulf Coast geopressured-geothermal energy conference: research and development.** Dorfman, M.H.; Fisher, W.L. (eds.). (Texas Univ., Austin (USA). Center for Energy Studies). Jun 1980. Contract AC08-79ET27018. 610p. (CONF-7910104—(Vol.3)). NTIS, PC A99/MF A01.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

Twenty-one papers are included. Separate abstracts were prepared for each one. (MHR)

37932 **Geothermal aspects of resource location.** Lindsay, D.R. (Shell Oil Co., Houston, TX). pp 97-105 of Geothermal environmental seminar-'78. Tucker, F.L.; Tanner, L.R. (eds.). Clearlake Oaks, CA; Lake County Printing (1978).

From Geothermal seminar; Sacramento, CA, USA (9 May 1978).

A wide variety of geological, geochemical and geophysical methods are used today in exploring for geothermal resouces. Each of these methods has some inferred relationship to heat, hydrothermal alteration, rock type, structure, fracturing or porosity, or the presence and nature of geothermal fluids in the subsurface. Any of these methods, used singly or in combination, can only indicate the possibility of a geothermal system at depth. The existence of a reservoir capable of sustained production of geothermal fluids at commercial rates can be proven only by the drilling and testing of one or more deep exploratory wells.

GEOPHYSICAL TECHNIQUES AND SURVEYS

37933 (DOE/ID/12079—7) **Delineation of an electrical resistivity anomaly, Malpais area, Beowawe KGRA, Eureka and Lander Counties, Nevada.** Smith, C. (Utah Univ., Salt Lake City (USA). Earth Science Lab.). Jul 1980. Contract AC07-80ID12079. 30p. NTIS, PC A03/MF A01.

A simple numerical model of previously released bipole-dipole resistivity data shows the margin of the graben to be anomalously conductive below the Malpais. The conductive area has been delineated with data from a dipole-dipole resistivity survey run in April 1980 for this study. Detailed numerical models of these data define a 1250 m wide body with resistivities less than 20 ohm-m that appear to connect The Geysers and the graben boundary. The minimum depth to the conductor is interpreted to be 375 m; its depth extent is undetermined. The electrical data do not resolve whether the anomaly below the Malpais may be the product of a defunct hydrothermal system or the signature of an active system. If thermal gradient data detect an enhanced heat flow anomaly in the same area, the Malpais may be a viable geothermal exploration target within the Beowawe KGRA.

37934 (DOE/NV/10072—1) **Temperature gradients in a portion of Michigan: a review of the usefulness of data from the AAPG geothermal survey of North America.** Vaught, T.L. (Gruy Federal, Inc., Arlington, VA (USA)). Aug 1980. Contract AC08-80NV10072. 43p. NTIS, PC A03/MF A01.

Temperature gradient data derived from drill holes in an east-west zone through the center of the southern peninsula of Michigan are analyzed. The purpose of this work is to investigate possible problems in utilizing the American Association of Petroleum Geologists data base. Michigan was chosen because a review of that State's geothermal potential shows inconsistencies between gradients from shallow wells and nearby deeper wells and because the geology of the State is relativey simple. The structure and stratigraphy are discussed because an understanding of Michigan basin geology makes it easier to predict the influence of lithology on the basin's geothermal gradients. Explanations for elevated gradients are reviewed. (MHR)

37935 (LBL—11221) **Controlled-source electromagnetic survey at Soda Lakes geothermal area, Nevada.** Stark, M.; Wilt, M.; Haught, J.R.; Goldstein, N. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1980. Contract W-7405-ENG-48. 98p. NTIS, PC A05/MF A01.

The EM-60 system, a large-moment frequency-domain electromagnetic loop prospecting system, was operated in the Soda Lakes geothermal area, Nevada. Thirteen stations were occupied at distances ranging from 0.5-3.0 km from two transmitter sites. These yielded four sounding curves--the normalized amplitudes and phases of the vertical and radial magnetic fields as a function of frequency--at each station. In addition, two polarization ellipse parameters, ellipticity and tilt angle, were calculated at each frequency. The data were interpreted by means of a least-squares inversion procedure which fits a layered resistivity model to the data. A three-layer structure is indicated, with a near-surface 20 ohm-m layer of 100-400 m thickness, a middle 2 ohm-m layer of approximately 1 km thickness, and a basement of greater than 10 ohm-m. The models indicate a northwesterly structural strike; the top and middle layers seem to thicken from northeast to southwest. The results agree quite well with previous results of dipole-dipole and magnetotelluric (MT) surveys. The EM-60 survey provided greater depth penetation (1 to 1.5 km) than dipole-dipole, but MT far surpassed both in its depth of exploration. One advantage of EM in this area is its ease and speed of operation. Another advantage, its relative insensitivity to lateral inhomogeneities, is not as pronounced here as it would be in areas of more complex geology.

37936 (UT/CES-CP—10(Vol.1), pp 312-372) **Wilcox Group - potential for geopressured geothermal sandstone reservoirs.** Edwards, M.B.; Bebout, D.G.; Gregory, A.R.; Weise, B.R. (Univ. of Texas, Austin). Jun 1980.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

The objective of this study is to identify areas along the Wilcox trend favorable for producing large quantities of hot water from the geopressured zone in order to separate methane from solution and produce electrical energy from heat. On the basis of maximum sandstone development and formation temperatures greater than 300°F (149°C), six geothermal fairways were delineated in Zapata, Duval, Live Oak, De Witt, Colorado, and Harris counties. In addition, detailed studies were conducted to identify sites for drilling test wells. The De Witt Fairway is considered the prime test site area; the Cuero Prospect contains more than 550 ft (170 m) of sandstone with an area of approximately 14 mi^2 (36 km^2). The prospective sandstones occur at the tops of at least eight coarsening upward cycles; progressively shallower cycles contain increasingly permeable sandstones deposited in more proximal deltaic environments. The Colorado Fairway contains the second test site area. The Eagle Lake Prospect contains 1240 ft (380 m) of sandstone and extends over an area of approximately 10 mi^2 (26 km^2). However, there is a question as to the presence of adequate thickness of high-permeability zones.

37937 (UT/CES-CP—10(Vol.1), pp 414-473) **Progress report on evaluation of entrained methane in deep reservoirs, Texas Gulf Coast.** Gregory, A.R.; Dodge, M.M.; Posey, J.S. (Univ. of Texas, Austin). Jun 1980.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

The major objective of this study is to appraise the total volume of in-place and recoverable methane dissolved in formation waters of sandstone reservoirs along the onshore Texas Gulf Coast from 8000 ft (approximate base of oil production) to the base of the Wilcox Group (deepest significant sandstone occurrence). Volume and distribution of potential reservoirs were determined by utilizing electric logs which form a grid of structural dip and strike cross sections that extend from near the Wilcox outcrop to the coastline. Total thickness and net-sandstone distribution maps were constructed for each formation. Significant amounts of sandstone are found in the Wilcox Group, Upper Claiborne (Yegua), Vicksburg, and Frio Formations. Only the Yegua Formation is not geopressured. The Texas Gulf Coast was divided into 24 subdivisions for purposes of detailed reservoir mapping and calculation of methane resource. Boundaries of these subdivisions were determined by structural provinces, the San Marcos arch and Houston and Rio Grande embayments, and by location of the Wilcox, Vicksburg, and Frio fault zones. Subdivision No. 2, in South Texas, was used to illustrate methods for evaluating bulk volume of sandstone, porosity, fluid pressure, temperature, salinity, and the amount of methane dissolved in formation waters.

37938 (UT/CES-CP—10(Vol.1), pp 474-514) **Prospect areas for testing entrained methane resources in the shallow geopressured and deep hydropressured zones, Texas Gulf Coast.** Weise, B.R.; Allie, A.D.; Bebout, D.G.; Edwards, M.B.; Gregory, A.R.; Hamlin, H.S.; Lockley, J.L. (Univ. of Texas, Austin). Jun 1980.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

Delineation of the four zones on regional cross sections and a survey of sandstone distribution defined sandstone-rich corridors for each of the zones. Net-sandstone maps defined high-sandstone fairways within the corridors. These fairways were ranked on the basis of net-sandstone thickness, areal sandstone distribution, average sandstone bed thickness, permeability, and coincidence with fairways of other zones. The most favorable prospective fairways within the Frio Formation are Cameron, Kenedy, Corpus Christi, and Matagorda; the Montgomery Fairway is within the Wilcox Group. One or two prospect areas within each fairway are being studied in detail. Several sites for wells which will test the various pressure zones will be selected within the prospect areas.

GEOCHEMICAL TECHNIQUES AND SURVEYS

REFER ALSO TO CITATION(S) 38015

37939 (LBL—11410) **Comparative assessment of five potential sites for hydrothermal magma systems: geochemistry.** White, A.F. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1980. Contract W-7405-ENG-48. 81p. NTIS, PC A05/MF A01.

A brief discussion is given of the geochemical objectives and questions that must be addressed in such an evaluation. A summary of the currently published literature that is pertinent in answering these questions is presented for each of the five areas: The Geysers-Clear Lake region, Long Valley, Rio Grand Rift, Roosevelt Hot Springs, and the Salton Trough. The major geochemical processes associated with proposed hydrothermal sites are categorized into three groups for presentation: geochemistry of magma and associated volcanic rocks, geochemistry of hydrothermal solutions, and geochemistry of hydrothermal alteration. (MHR)

37940 (UT/CES-CP—10(Vol.1), pp 168-199) **Geochemistry of formation waters from Pleasant Bayou No. 2 well and adjacent areas in coastal Texas.** Kharaka, Y.K.; Lico, M.S.; Wright, V.A.; Carothers, W.W. (Geological Survey, Menlo Park, CA). Jun 1980.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

Pleasant Bayou No. 2 in Brazoria County, Texas, is the first well drilled and completed exclusively for evaluating the energy resources from geopressured-geothermal zones. Water samples were obtained from two sandstone units in the geopressured zone (4737-4740m and 4453-4471m) during production tests of these units. Thirty formation-water samples were also obtained from normally and geopressured zones from five oil and gas fields located to the east and north of the test well in Brazoria and Galveston Counties, Texas. All the samples are from sandstone units within the Frio Clay of Oligocene (?) age. Detailed chemical and isotope analyses of the waters show that: (1) the salinities of water from Pleasant Bayou well are 110,000 and 130,000 mg/L for the lower and upper sandstone units, respectively; (2) the salinity of water in the geopressured zone from the oil and gas fields ranges from about 55,000 to 75,000 mg/L dissolved solids - the salinity of water in the overlying normally pressured zone is lower and the two waters are not chemically compatible; (3) all the formation waters are modified marine connate waters of the Na-Cl type; (4) Na and Cl constitute more than 90 and 95 percent of cations and anions, respectively; and (5) the concentrations of H_2S (<2 mg/L), SiO_2 (<120 mg/L), and toxic trace metals are low in comparison with most geothermal waters, but the concentrations of boron (as much as 90 mg/L) and NH_3 (as much as 120 mg/L) are moderately high.

37941 (UT/CES-CP—10(Vol.3), pp 1327-1346) **Results of flow tests of Edna Delcambre No. 1. I. Summary of water analyses.** Hankins, B.E.; Chavanne, R.E.; Ham, R.A.; Karkalits, O.C.; Palermo, J.I. (McNeese State Univ., Lake Charles, LA). Jun 1980.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

DOE funded a proposal by McNeese State University in June 1975 to test a shut-in gas well that penetrated the geopressured zone. The McNeese team obtained samples of water from the well and determined the chemical composition of each. The Edna Delcambre et al. No. 1, located in Tigre Lagoon Field, East Vermilion Parish, Louisiana, was chosen as the test well. Two sands at approximately 12,700 feet were tested for about 20 days each. A summary of the test equipment available and the analyses performed on-site as well as the analyses performed at the McNeese laboratories is discussed. A comparison of laboratory and in-line pH determinations is made in order to show some of the problems involved in testing geopressured-geothermal water. Recommendations are made regarding the testing of future wells.

37942 (UT/CES-CP—10(Vol.3), pp 1347-1371) **Results of flow tests of Edna Delcambre No. 1. II. Summary of gas analyses.** Karkalits, O.C.; Hankins, B.E. (McNeese State Univ., Lake Charles, LA). Jun 1980.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

One of the major objectives of the flow tests was to determine the amount of gas dissolved in the geopressured brine. The gas/water ratio was measured on bottom-hole samples, as well as on flowing streams from the gas/water separator. Problems connected with gas/water ratio from bottom-hole samples are discussed. Gas analyses are presented, along with a discussion of recombination and differential liberation study results. The latter studies were made to determine the solubility limit of the dissolved gas in the geopressured brine. At the reservoir temperature and pressure (about 240°F and 11,000 psi), this value was found to be 24 scf per barrel. The gas/water ratio, measured by surface equipment, was found to be 44-88 scf/bbl. The natural gas associated with the geopressured brine was of pipeline quality (after dehydration), and had a heating value (HHV) of about 1040 Btu/scf.

37943 (UT/CES-CP—10(Vol.3), pp 1372-1385) **Comparison of selected parameters from tested geopressured-geothermal wells.** Ham, R.A.; Beck, J.N.; Chavanne, R.E.; Hankins, B.E.; Palermo, J.I.; Rogers, S.W. (McNeese State Univ., Lake Charles, LA). Jun 1980.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

Selected results of analysis of fluids from the Edna Delcambre # 1 and the Fairfax Foster Sutter # 2 wells are presented. A comparison of parameters such as pH, silicate, and total dissolved solids is made between the two wells. Chemical and mechanical factors are cited to explain differences in these parameters.

37944 **Chemical logging of geothermal wells.** Allen, C.A.; McAtee, R.E. (to Dept. of Energy). US Patent Application 105,337. [nd]. Filed date 19 Dec 1979. 15p.

The presence of geothermal aquifers can be detected while drilling in geothermal formations by maintaining a chemical log of the ratio of the concentrations of calcium to carbonate and bicarbonate ions in the return drilling fluid. A continuous increase in the ratio of the concentrations of calcium to carbonate and bicarbonate ions is indicative of the existence of a warm or hot geothermal aquifer at some increased depth.

EXPLORATORY DRILLING AND WELL LOGGING

REFER ALSO TO CITATION(S) 37936, 37944, 38037, 38043

37945 (DOE/ET/27086—1) **Establishment of viscometer capability for geopressured fluids. Project 61024 final report, November 19, 1978-December 31, 1979.** Rockar, E.; Randolph, P. (Institute of Gas Technology, Chicago, IL (USA)). Oct 1980. Contract AC08-78ET27086. 25p. NTIS, PC A02/MF A01.

The feasibility of modifying the IGT capillary viscometer for the measurement of methane-saturated brines at 10,000 psi and 200°C was evaluated. The viscometer was cleaned, modified, reassembled and pressure treated. The density cells were calibrated to a precision of approximately 7%. The viscosity of pure value was measured and the best value obtained was 6% below values reported in the literature. The operation of the viscometer was time-consuming and required meticulous cleaning between experiments. Some corrosion at the mercury surface interfered with the efficient operation of the timing device. Other problems were encountered due to gas bubbles trapped in the capillary flow path. Consequently, data on methane-saturated brine could not be obtained within the funding limitations of this program. It is concluded that further work on the existing viscometer would not be cost-effective.

37946 (IDO—10096) **Completion and testing report: INEL Geothermal Exploratory Well One (INEL-1).** Prestwich, S.M.; Bowman, J.A. (Department of Energy, Idaho Falls, ID (USA). Idaho Operations Office; EG and G Idaho, Inc., Idaho Falls (USA)). Feb 1980. Contract AC07-76ID01570. 50p. NTIS, PC A03/MF A01.

INEL Geothermal Exploratory Well One (INEL-1) was drilled in search of a goethermal resource beneath the Snake River Plain for use at the Chemical Processing Plant (CPP) on the Idaho National Engineering Laboratory Site. The drilling site was selected as the most promising location within reasonable distance of the CPP. The resource was thought to be located at a depth near 7500 ft (2300 m). Neither significant production nor high temperatures were noted at that depth, and the well was then drilled to 10,333 ft (3150 m) with similar findings. Rock cores, geophysical logs, and hydrologic tests of the well to date indicate that no useful geothermal resource exists at this location. Information is presented on the drilling, completion, and testing of INEL-1.

37947 (UT/CES-CP—10(Vol.1), pp 11-45) **Geological aspects of Pleasant Bayou geopressured geothermal test well, Austin Bayou Prospect, Brazoria County, Texas.** Bebout, D.G.; Loucks, R.G.; Gregory, A.R. (Univ. of Texas, Austin). Jun 1980.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

The Bureau of Economic Geology (BEG) has been conducting regional and site-specific geothermal studies of the sandstones in

the Frio Formation and Wilcox Group in Texas, with the objective of assessing and testing the potential of producing heat energy and methane from the Gulf Coast geopressured zone. Regional geological studies of the Frio Formation in Texas resulted in the delineation of several geothermal fairways which contain thick sandstones with fluid temperatures greater than 300°F (149°C); additional studies of these fairways indicated that only one of these, the Brazoria Fairway, contained sandstones with permeabilities greater than the 20 md required to produce fluids at high rates needed for a successful geothermal well. Through further detailed mapping, the Austin Bayou Prospect was identified within the fairway, and a test-well site area was outlined within this prospect. The Department of Energy and General Crude Oil (GCO/DOE) No. 2 Pleasant Bayou well drilled on the actual test-well site to a total depth of 16,500 ft (5029 m) encountered the T5 marker at 13,960 ft (4255 m) indicating a slightly steeper dip into the salt-withdrawal basin than originally predicted. A total of 660 ft (201 m) of net sandstone is present beneath the T5 marker, slightly less than the 690 ft (210 m) expected. Present perforations are in the fluvial sandstones of the C, D, and E depositional cycles. (MHR)

37948 (UT/CES-CP—10(Vol.1), pp 46-84) **Factors controlling porosity and permeability in geopressured Frio sandstone reservoirs, General Crude Oil/Department of Energy Pleasant Bayou test wells, Brazoria County, Texas.** Loucks, R.G.; Richmann, D.L.; Milliken, K.L. (Univ. of Texas, Austin). Jun 1980.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

Reservoir characteristics of Frio sandstones in the GCO/DOE Pleasant Bayou No. 1 and No. 2 wells are influenced by depositional environment, sandstone composition, and diagenetic history. The sandstones and shales were deposited in delta plain, delta front, prodelta, and continental slope environments. Fluvial channel and distributary-mouth bar sandstones are most favorable for development and preservation of porosity. Sandstones in the geopressured zone are lithic arkoses and feldspathic litharenites. Depositional matric (detrital material less than 20 μm in size) occluded most or all of the potential primary porosity between grains in many of the fine-grained sandstones at the time of deposition. Quartz, calcite, and kaolinite cements reduced both primary and secondary porosity during diagenesis. The most porous sandstones contain no depositional matrix, but may contain abundant cement. Depositional matrix not only plugs pore spaces between grains but prohibits the flow of fluids that may create secondary porosity by the dissolution of grains. Cements are not abundant enough to prevent fluids from flowing through the sandstones. Consequently, even if cements are present, dissolution of grains and development of secondary porosity do take place. Permeable geopressured sandstone reservoirs are characterized by porosity that is dominantly secondary.

37949 (UT/CES-CP—10(Vol.1), pp 85-131) **Visual kerogen and vitrinite reflectance analyses of the Pleasant Bayou No. 1 Well, Brazoria County, Texas.** Schwab, K.W. (Geo-Strat, Inc. Houston, TX). Jun 1980.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

Visual kerogen and vitrinite reflectance analyses of forty (40) well cuttings samples and two (2) core specimens from the Pleasant Bayou No. 1 well show that the maturation of the sediments ranges from immature at 2894 feet to marginally mature at 16,500 feet. A significant jump in the thermal maturation index, T.A.I., occurs near the T-3 seismic horizon of the Frio Formation. Whether this jump represents a regional unconformity, a change in the environment of deposition, or a change in the quality of the drill cuttings is unclear. Although the present temperature of the sediments at 16,500 feet is in excess of 325°F, the color of the extracted palynomorphs indicates that the paleotemperature was considerably less, probably in the range of 190 to 200°F.

37950 (UT/CES-CP—10(Vol.1), pp 132-152) **Hydrocarbon source facies analysis, Department of Energy and General Crude Oil Company Pleasant Bayou No. 1 and 2 Wells, Brazoria County, Texas.** Brown, S.W. (GeoChem Laboratories, Inc., Houston, TX). Jun 1980.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

The stratigraphic section penetrated by the No. 1 and No. 2 Pleasant Bayou Wells, Brazoria County, Texas, over the gross well interval 2072 +- feet to 16,500 +- feet, contains zones with little or no potential for indigenously generated hydrocarbons. With the exception of a very thin interval at approximately 7000 feet, the entire evaluated section is considered immature and organically lean and has no significant potential for generating producible quantities of either liquid or gaseous hydrocarbons. The organic rich interval, which extends from approximately 6800 +- feet to 7400 +- feet, contains significant amounts of coal which may have generated large quantities of dry methane gas during the coalification process. Although large quantities of methane were not detectable within these sediments, the possibility exists that producible accumulations may exist within this interval in the local vicinity of this well.

37951 (UT/CES-CP—10(Vol.1), pp 153-167) **Shale mineralogy of the No. 1 Pleasant Bayou geothermal test well: a progress report.** Freed, R.L. (Trinity Univ., San Antonio, TX). Jun 1980.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

Thirty-three shale samples, ranging in depth from 2185 to 15,592 ft, were examined by x-ray diffraction methods to determine changes in mineralogy with depth. Quartz is present in all samples and averages 15 weight percent (wt%). Above 7800 ft, calcite content varies due to fossil fragments. Below 7800 ft. calcite content ranges from 0-9 wt%. Total clay content, combining kaolinite, illite, mixed-layer illite-montmorillonite (I/M), and traces of chlorite, is essentially constant, averaging 65 wt%. Individual clay minerals have quite variable contents from sample to sample, but distinct trends are noted: (1) kaolinite content is constant at an average of 25% total clay; (2) illite content initially averages 35% total clay, decreases with depth, and is zero in 10 of the 14 samples below 10,000 ft; and (3) mixed-layer I/M averages 40% total clay in shallow samples and 70% in deeper samples. The top of the geopressured zone, occurring at a fluid pressure gradient of 0.465 psi/ft and equilibrium temperature of about 190°F, is marked by a definite increase of illite in mixed-layer I/M at approximately 8500 ft. A major change in montmorillonite content from 60% at 11,210 ft, to 16% at 11,750 ft, corresponds to a pressure gradient of 0.7 psi/ft, and equilibrium temperature of 250°F.

37952 (UT/CES-CP—10(Vol.1), pp 235-311) **Geopressured formation parameters, geothermal well, Brazoria County, Texas.** Gregory, A.R.; Backus, M.M. (Univ. of Texas, Austin). Jun 1980.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

Evaluation of geopressured formation parameters for the General Crude-Department of Energy No. 1 and No. 2 Pleasant Bayou wells was done by analysis of data from cores, drill stem tests, conventional well logs, and digitized long-spaced sonic logs. Methods for estimating formation pressure from mud weight, shale resistivity, and transit time are compared with drill stem test data for wells in the area and are examined critically to determine their applicability to the Pleasant Bayou wells.

37953 (UT/CES-CP—10(Vol.2), pp 519-545) **Testing of geopressured Miocene sands for the dissolved methane resource in the Tenneco Fee N No. 1 well.** Braden, M.W. Jr.; Goode, O.N. Jr. (Tenneco Oil Co., Houston, TX). Jun 1980.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

A geothermal-geopressured, dissolved methane (GEO^2) alternate energy resource evaluation test will be conducted by Tenneco Oil Exploration and Production at a recently drilled and cased deep wildcat well in Terrebonne Parish, Louisiana. The localized geology, the proposed completion design, and the proposed testing in Middle Miocene sands between 14,750 feet and 17,276 feet using the Tenneco Fee N No. 1 well are described. The first sand interval to be tested is located below 17,098 feet and is indicated to have above 300°F and 15,000 psi downhole conditions. The testing will be performed in late 1979 and early 1980 with designed production from one or more sands approaching 30,000 barrels of water per day. An objective of this test will be definition of the parameters necessary to develop this potential alternate energy resource.

37954 (UT/CES-CP—10(Vol.2), pp 835-847) **Surface facilities for resource evaluation studies at Pleasant Bayou test well site.** Stevens, J.E. (Mobil-General Crude Corp., Dayton, TX); Lamb, J.P. Jun 1980.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

First stage construction of surface facilities will include only a relatively small amount of equipment, primarily a wellhead choke and high-pressure gas separator. Brine pressure will be maintained at 1000 psia downstream of the separator so that no additional pumping will be required for reinjection (into Pleasant Bayou No. 1 well). Extensive instrumentation will be installed to determine pressures, temperatures, gas content, water chemistry, and corrosion characteristics. After analysis of data from the initial production tests, a decision will be made on specific facilities required for the long-term test program. It is anticipated, for example, that an additional gas separator (low pressure) will be installed along with fan-type brine coolers and a system of tanks for water clarification. Also required will be a battery of high-pressure pumps for reinjecting the spent brine and a gas processing unit for delivering pipeline quality methane.

37955 (UT/CES-CP—10(Vol.3), pp 1137-1159) **Study of a geopressured reservoir by drilling and producing a well in a limited geopressured water sand.** Hamilton, J.R.; Wilson, J.S. (Dow Chemical U.S.A., Freeport, TX). Jun 1980.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

A 13,600' well will be drilled in Parcperdue field, near Lafayette, Louisiana, to test a small, geopressured water sand. Excellent geologic control of the fault block and uniformity of the reservoir sand will afford detailed analysis of reservoir behavior. The data generated will permit extrapolation to predict the performance of larger reservoirs. Water will be produced through 5-1/2" tubing at rates up to 25,00 bbl/day. The completion will be a cased hole gravel pack. The disposal well will be 5000' open hole gravel pack. The testing program will include detailed logging, coring and core analyses, analytical chemistry of water and gas, and PVT analyses. Pressure testing will consist of a short-term, 2-week series of four, staged isochronal pressure drawdown and buildup tests, followed by a long-term production test of approximately 9 months' duration. Periodic pressure buildup monitoring will be done during the long-term testing. A Hewlett-Packard temperature-pressure gauge will be utilized for both short- and long-term pressure testing.

37956 (UT/CES-CP—10(Vol.3), pp 1263-1270) **Computerized log analysis: a non-black box approach.** Potter, J.; Rusk, M.; Schneider, R.; Hill, T. (Univ. of Texas, Austin). Jun 1980.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

A Geopressured Geothermal Information System (GGIS) is being developed as a part of the Geothermal Energy Research Program of the Center of Energy Studies (CES), The University of Texas at Austin. GGIS has developed a system of log analysis routines which will develop and plot sand and salinity profiles. Input data are the digitized SP log and header data. Additional routines provide SP correction utilizing the digitized resistivity log. The system, dubbed ANALYSE, enables the user of a Tektronix terminal to inspect the log, sand profile, and shale base-line data being used by ANALYSE. As many data windows may be inspected as desired. The routine then gives the user the option of requesting a new sand profile run using new zoning parameters. In effect, the analyst is able to draw the shale base-line and sand profiles to his own standards using the computer as a high-speed tool.

37957 (UT/CES-CP—10(Vol.3), pp 1439-1467) **Analysis of Cameron Parish geopressured-geothermal aquifer, Sweet Lake prospect.** Durham, C.O. Jr. (Magma Gulf Co., Houston, Texas); Parsons, B.E.; Rodgers, R.W. . Jun 1980.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

The Sweet Lake geopressured-geothermal prospect is located in northern Cameron Parish, Louisiana, in T.12S., R.7W. and T.12S., R.8W. approximately 10 to 15 miles south of Lake Charles. The region is characterized by Cenozoic sand and clay deposits of geosynclinal thickness and differentially uplifted salt structures. The primary geopressured-geothermal aquifer is the Miogyp sand of the Camerina zone (Upper Frio formation of Oligocene-Miocene age). The main prospect is located in a basin on the north flank of the Hackberry-Big Lake-Sweet Lake salt ridge. Interpretation of 27 miles of seismic lines and 17 deep well logs localizes the prospect in a basin with northwesterly dip in a graben between east-west faults converging eastward. Aquifer depth ranges from 14,000 to 18,000 feet. Net sand thickness exceeds 400 feet with 22% porosity. Temperatures range from 280°F (corrected) at 14,000 feet to 350°F at 18,000 feet. Geopressures occur below 9000 feet with mud weight equivalents in the sand from 12 to 13 pounds per gallon. Net sand volume of one cubic mile is estimated in the area mapped.

LEGAL AND INSTITUTIONAL ASPECTS

REFER ALSO TO CITATION(S) 37912, 37913, 37914, 37974, 37987, 38232

37958 (DOE/ID/12012—1) **South Dakota geothermal handbook.** (South Dakota Office of Energy Policy, Pierre (USA)). Jun 1980. Contract FC07-79ID12012. 66p. NTIS, PC A04/MF A01.

The sources of geothermal fluids in South Dakota are described and some of the problems that exist in utilization and materials selection are described. Methods of heat extraction and the environmental concerns that accompany geothermal fluid development are briefly described. Governmental rules, regulations and legislation are explained. The time and steps necessary to bring about the development of the geothermal resource are explained in detail. Some of the federal incentives that encourage the use of geothermal energy are summarized. (MHR)

37959 (DOE/ID/12014—2) **Montana geothermal handbook.** Perlmutter, S.; Birkby, J. (Montana Dept. of Natural Resources and Conservation, Helena (USA). Renewable Energy Bureau). Fal 1980. Contract FC07-79ID12014. 101p. NTIS, PC A06/MF A01.

The permits required for various geothermal projects and the approximate time needed to obtain them are listed. A brief discussion of relevant statutes and regulations is included. Some of the state and federal grant and loan programs available to a prospective geothermal developer are described. The names and addresses of relevant state and federal agencies are given. Legal citations are listed. (MHR)

37960 (UCRL—52970) **Geothermal energy and the land resource: conflicts and constraints in The Geysers-Calistoga KGRA.** O'Banion, K.; Hall, C. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 14 Jul 1980. Contract W-7405-ENG-48. 41p. NTIS, PC A03/MF A01.

This study of potential land-related impacts of geothermal power development in The Geysers region focuses on Lake County because it has most of the undeveloped resource and the least regulatory capability. First, the land resource is characterized in terms of its ecological, hydrological, agricultural, and recreational value; intrinsic natural hazards; and the adequacy of roads and utility systems. Based on those factors, the potential land-use conflicts and constraints that geothermal development may encounter in the region are identified and the availability and relative suitability of land for such development is determined. A brief review of laws and powers germane to geothermal land-use regulation is included.

37961 (UT/CES-CP—10(Vol.3), pp 1468-1483) **Legal-regulatory status report for Texas.** Oberbeck, A.W. (Univ. of Texas, Austin). Jun 1980.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

State actions to alleviate legal problems in geopressured-geothermal resource development in Texas are summarized. Legislative actions include a policy statement on resource ownership and a clarification of responsibility for waste disposal. The Railroad Commission has modified some regulations. Federal environmental regulations, particularly new programs proposed to implement statutes not yet enforced, are reviewed. These include a new hazardous waste management system proposed to implement the Resource Conservation and Recovery Act, a modified proposal for underground injection controls under the Safe Drinking Water Act, and new rules for prevention of significant deterioration of air quality under the Clean Air Act. Continuing legal problem areas not yet resolved, generally because of inadequate technical knowledge of reservoir characteristics and long-term performance, are surveyed.

37962 (UT/CES-CP—10(Vol.3), pp 1574-1601) **Summary of industry-government conferneces and process heat market survey.** Prestwood, D.C.L.; Frederick, D.O.; Roberts, K.D.; Vanston, J.H. Jr. (Univ. of Texas, Austin). Jun 1980.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

The successful development of the geopressured-geothermal resource along the Texas Gulf Coast depends in part on the impacts and mix of incentives offered by governmental agencies; there exists a variety of opinions as to which incentives offer the most motivation to the private sector. This report presents the results of a series of four meetings held on December 5 and 6, 1978, in Houston, Texas, at which incentives were discussed by members of the research team, DOE representatives, and representatives from four categories of potential geopressured-geothermal developers. These categories were: electric utilities and architectural engineering firms, large industrial energy consumers, gas transmission and distribution companies, and energy production companies and financial institutions. All groups viewed geopressured-geothermal as an industry in its initial stages still requiring considerable research and development before it can become economically feasible. Therefore, they endorsed DOE's well-drilling program. They also agreed that current geothermal tax incentives due to expire either in 1982 or 1984 must be extended if they are to have any effect on commercialization. Other areas of concern developed by the participants included applications for geothermal heat and hot water, possible subsidence from deep-well withdrawal, possible aquifer contamination from reinjection, and the geophysical characteristics of geopressured-geothermal formations.

37963 (UT/CES-CP—10(Vol.3), pp 1642-1690) **Assessing the socioeconomic impact of geopressured/geothermal energy development in coastal Louisiana: a preliminary report.** Grimes, M.D.; Saucier, D.L. (Louisiana State Univ., Baton Rouge). Jun 1980.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

The initial analysis of the potential socioeconomic impact of geopressured/geothermal energy development for parishes in coastal Louisiana containing five targeted development sites is reported. After a wide variety of different indicators was reviewed, a set was selected to represent five different dimensions of the socioeconomic structure of the parishes. These dimensions are: (1) population size and composition, (2) education and training, (3) income and tax base, (4) labor-force composition, and (5) health-care and social services. Using these variables, baseline data profiles for each parish are constructed and compared to both state planning district and state

totals. These profiles are then used as a benchmark for assessing the potential socioeconomic impacts of a range of geopressured/geothermal energy development alternatives on the host parishes.

37964 Recommendations of the California geothermal resources task force of 1977. Grew, P. pp 14-20 of Geothermal environmental seminar-'78. Tucker, F.L.; Tanner, L.R. (eds.). Clearlake Oaks, CA; Lake County Printing (1978).

From Geothermal seminar; Sacramento, CA, USA (9 May 1978).

The following topics are covered: the importance of geothermal energy to California, the state geothermal task force, the work of the task force, the regulatory system for geothermal development in California, task force recommendations for regulatory change, and other recommendations. (MHR)

37965 Energy commission geothermal obligations. Reed, S. pp 21-33 of Geothermal environmental seminar-'78. Tucker, F.L.; Tanner, L.R. (eds.). Clearlake Oaks, CA; Lake County Printing (1978).

From Geothermal seminar; Sacramento, CA, USA (9 May 1978).

The recommendations of the Energy Commission's Geothermal Policy Committee for a policy and regulatory approach that will be the basis of the Commission's geothermal resource development and power plant siting process are presented.

37966 BLM activity in geothermal resources. Hastey, E. pp 34-38 of Geothermal environmental seminar-'78. Tucker, F.L.; Tanner, L.R. (eds.). Clearlake Oaks, CA; Lake County Printing (1978).

From Geothermal seminar; Sacramento, CA, USA (9 May 1978).

The Bureau of Land Management is the representative and agent of the Secretary of the Interior for the administration of the federal geothermal leasing program. The BLM is responsible for issuing and administering geothermal leases on federal lands, and for the supervision of activities outside the area of actual operations. A role as surface supervisor for multiple-use resource management is also maintained. Various ramifications of the BLM's functions are discussed. (MHR)

37967 Ownership rights in geothermal resources. Million, S.A. pp 50-53 of Geothermal environmental seminar-'78. Tucker, F.L.; Tanner, L.R. (eds.). Clearlake Oaks, CA; Lake County Printing (1978).

From Geothermal seminar; Sacramento, CA, USA (9 May 1978).

The legal approaches which regard geothermal resources as mineral, water, or neither of the two are described. Court cases involved in these approaches are reviewed briefly. (MHR)

37968 Geothermal program of DOE, division of geothermal energy. Toms, R.S.H. pp 71-75 of Geothermal environmental seminar-'78. Tucker, F.L.; Tanner, L.R. (eds.). Clearlake Oaks, CA; Lake County Printing (1978).

From Geothermal seminar; Sacramento, CA, USA (9 May 1978).

The Division of Geothermal Energy of DOE has the major federal role in accelerating the development of geothermal energy. The Division has a mission-oriented strategy, and is currently reorganizing into three regional teams which are planning detailed scenarios to ensure the relevance and timeliness of the Federal program.

37969 Agency control and restrictions of construction activity for geothermal development. Ruzicka, C.D. pp 76-81 of Geothermal environmental seminar-'78. Tucker, F.L.; Tanner, L.R. (eds.). Clearlake Oaks, CA; Lake County Printing (1978).

From Geothermal seminar; Sacramento, CA, USA (9 May 1978).

This policy and procedure describes and deals with the control, regulation and restrictions of construction of access roads, drill pad sites, holding sumps and related items as exercised by the County of Lake for geothermal development. (MHR)

37970 Permit coordination for geothermal projects. Tobias, K.J. pp 82-84 of Geothermal environmental seminar-'78. Tucker, F.L.; Tanner, L.R. (eds.). Clearlake Oaks, CA; Lake County Printing (1978).

From Geothermal seminar; Sacramento, CA, USA (9 May 1978).

The provisions of California legislation AB 884 relative to the geothermal permitting process are described. (MHR)

ECONOMIC AND FINANCIAL ASPECTS

REFER ALSO TO CITATION(S) 37917, 37963

37971 (UT/CES-CP—10(Vol.3), pp 1499-1509) **Sensitivity of the economics of a geopressured energy prospect to variation in geologic parameters.** Ray, T.G.; Johnson, A.E. Jr. (Louisiana State Univ., Baton Rouge). Jun 1980.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

The effects of changes in geologic parameters upon economic indicators are analyzed, such as net present value (NPV), for a specific geopressured prospect site, using the techno-economic simulation model described in a separate presentation at this conference. Results are presented showing the variations in the economic indicators with geologic parameters such as reservoir size, effective compressibility, porosity, permeability, etc. Those parameters which were found to be most important (that is, have major effects when varied to the extent of their uncertainty range) are identified. These results are subject to the assumption that an aquifer brine is saturated with methane at the temperature, pressure, and salinity predicted for it. The saturated methane amount was calculated quite accurately within the ranges of the variables encountered in Louisiana aquifers by a correlation of the available literature data.

37972 (UT/CES-CP—10(Vol.3), pp 1510-1541) **Report on the economic analyses completed to date of the most promising geopressured energy prospects in Louisiana.** Johnson, A.E. Jr.; Wrighton, F.M.; Ray, T.G. (Louisiana State Univ., Baton Rouge). Jun 1980.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

Five geopressured/geothermal prospects have been identified and described. These five sites have been the subject of substantial analysis utilizing a techno-economic simulation model. A primary objective of this analytical work is to identify scenarios that would provide an environment conducive to the private development and exploitation of the resource. Consequently, the economics of the development of the resource have played a major role in our analyses. The base case for comparison of the sites to alternative investments has been established representing the best estimates of anticipated future investment, costs, and revenues under the existing regulatory, statutory, and institutional framework. The results of this base case analysis are reported for each site and the source of the differences identified. Scenarios in the form of recommended changes in the base case framework identified above are discussed and the economic sensitivity of changes in the framework identified.

37973 (UT/CES-CP—10(Vol.3), pp 1545-1573) **Resource assessment, scheduling, and economics of developing the geopressured-geothermal resource in Texas.** Cornwell, J.B.; Lesso, W.G.; Zinn, C.D. (Univ. of Texas, Austin). Jun 1980.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

For the geopressured-geothermal resource to be a viable source of energy, a number of physical and economic conditions must be met. A fair amount of uncertainty exists with regard to these factors. In order to evaluate the impact of these uncertainties, a series of models has been developed to assess the feasibility of the resource under known and/or best estimate conditions and to determine the minimum acceptable values. The first model assesses the individual fairways' ability to provide a designated flow for one well for a set minimum lifetime. The fairways which cannot meet the minimum requirements are dismissed as possible development candidates. The second model takes the usable fairways and produces a development scenario based upon chosen hit probabilities. This model yields a time line for the introduction of the resource based upon the aggressivness of the development chosen, i.e., the number of rigs available. The third model performs an economic analysis of the fairway development scenarios based upon the time line history, total number of wells required, and total methane recovered. This analysis uses a present worth analysis that takes into account the required investment, revenues, operating cost, and economic life. Currently, only a few of the fairways show promise of being viable sources based on physical properties, and then only if the price of natural gas is substantially increased over its current value.

37974 (UT/CES-CP—10(Vol.3), pp 1602-1641) **Analysis of government incentives and resource utilization profiles.** Frederick, D.O.; Prestwood, D.C.L.; Roberts, K.D.; Vanston, J.H. Jr. (Univ. of Texas, Austin). Jun 1980.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

Numerous government initiatives have been undertaken in recent years which have impacts on geopressured-geothermal development. This presentation (1) examines the applicability of the Geothermal Loan Guaranty Program to geopressured development, (2) explains DOE-DGE well-drilling plans (as budgeted), (3) examines federal tax incentives to geopressured development, (4) discusses geopressured methane price incentives and disincentives, (5) explains the Economic Regulatory Administrations's ruling allowing geopressured methane boiler fuel, and incentives and disincentives; and, finally, regulatory disincentives to the non-utility generation of electricity or remote transportation of geopressured methane are

discussed. The four utilization profiles research suggests are most likely to constitute, in some mix, the overall structure, given perpetuation of the current pattern of government initiatives are detailed and rationalized. (MHR)

ENVIRONMENTAL ASPECTS AND WASTE DISPOSAL

REFER ALSO TO CITATION(S) 37918, 37928, 37969, 37970, 38006, 38036

37975 (DOE/EV—0092(Vol.1)) **Assessment of geothermal development in the Imperial Valley of California. Volume 1. Environment, health, and socioeconomics.** Layton, D. (ed.). (California Univ., Livermore (USA). Lawrence Livermore National Lab.). Jul 1980. Contract W-7405-ENG-48. 242p. NTIS, PC A11/MF A01.

Utilization of the Imperial Valley's geothermal resources to support energy production could be hindered if environmental impacts prove to be unacceptable or if geothermal operations are incompatible with agriculture. To address these concerns, an integrated environmental and socioeconomic assessment of energy production in the valley was prepared. The most important impacts examined in the assessment involved air quality changes resulting from emissions of hydrogen sulfide, and increases in the salinity of the Salton Sea resulting from the use of agricultural waste waters for power plant cooling. The socioeconomics consequences of future geothermal development will generally be beneficial. (MHR)

37976 (DOE/EV—0092(Vol.2)) **Assessment of geothermal development in the Imperial Valley of California. Volume 2. Environmental control technology.** Morris, W.; Hill, J. (eds.). (California Univ., Livermore (USA). Lawrence Livermore National Lab.). Jul 1980. Contract W-7405-ENG-48. 131p. NTIS, PC A07/MF A01.

Environmental control technologies are essential elements to be included in the overall design of Imperial Valley geothermal power systems. Environmental controls applicable to abatement of hydrogen sulfide emissions, cooling tower drift, noise, liquid and solid wastes, and induced subsidence and seismicity are assessed here. For optimum abatement of H_2S under a variety of plant operating conditions, removal of H_2S upstream of the steam turbine is recommended. The environmental impact of cooling tower drift will be closely tied to the quality of cooling water supplies. Conventional noise abatement procedures can be applied and no special research and development are needed. Injection technology constitutes the primary and most essential environmental control and liquid waste disposal technology for Imperial Velley geothermal operations. Subsurface injection of fluids is the primary control for managing induced subsidence. Careful maintenance of injection pressure is expected to control induced seismicity. (MHR)

37977 (DOE/RA/27181—01) **Demonstration of EIC's copper sulfate process for removal of hydrogen sulfide and other trace contaminants from geothermal steam at turbine inlet temperatures and pressures. Final report.** (Pacific Gas and Electric Co., San Francisco, CA (USA)). May 1980. Contract FC03-78ET27181. 141p. NTIS, PC A07/MF A01.

The results obtained during the operation of an integrated, one-tenth commercial scale pilot plant using EIC's copper sulfate process for the removal of hydrogen sulfide and other contaminants from geothermal steam at turbine upstream conditions are discussed. The tests took place over a six month period at Pacific Gas and Electric Company's Unit No. 7 at The Geysers Power Plant. These tests were the final phase of a development effort which included the laboratory research and engineering design work which led to the design of the pilot plant. Broadly, the objectives of operating the pilot plant were to confirm the preliminary design criteria which had been developed, and provide data for their revisions, if appropriate, in a plant which contained all the elements of a commercial process using equipment of a size sufficient to provide valid scale-up data. The test campaign was carried out in four phases: water testing; open circuit, i.e., non integrated scrubbing, liquid-solid separation and regeneration testing; closed circuit short term; and closed circuit long term testing.

37978 (SAND—80-7047) **Use of data obtained from core tests in the design and operation of spent brine injection wells in geopressured or geothermal systems.** Jorda, R.M. (Completion Technology Co., Houston, TX (USA)). Mar 1980. Contract AC04-76DP00789. 156p. NTIS, PC A08/MF A01.

The effects of formation characteristics on injection well performance are reviewed. Use of data acquired from cores taken from injection horizons to predict injectivity is described. And methods for utilizing data from bench scale testing of brine and core samples to optimize injection well design are presented. Currently available methods and equipment provide data which enable the optimum design of injection wells through analysis of cores taken from injection zones. These methods also provide a means of identifying and correcting well injection problems. Methods described in this report are: bulk density measurement; porosity measurement; pore size distribution analysis; permeability measurement; formation grain size distribution analysis; core description (lithology) and composition; amount, type and distribution of clays and shales; connate water analysis; consolidatability of friable reservoir rocks; grain and pore characterization by scanning electron microscopy; grain and pore characterization by thin section analysis; permeability damage and enhancement tests; distribution of water-borne particles in porous media; and reservoir matrix acidizing effectiveness. The precise methods of obtaining this information are described, and their use in the engineering of injection wells is illustrated by examples, where applicable. (MHR)

37979 (UCRL—15283) **Environmental overview of geothermal development: northern Nevada.** Slemmons, D.B.; Stroh, J.M.; Whitney, R.A. (eds.). (Nevada Univ., Reno (USA). Mackay School of Mines). Aug 1980. Contract W-7405-ENG-48. 301p. NTIS, PC A14/MF A01.

Regional environmental problems and issues associated with geothermal development in northern Nevada are studied to facilitate environmental assessment of potential geothermal resources. The various issues discussed are: environmental geology, seismicity of northern Nevada, hydrology and water quality, air quality, Nevada ecosystems, noise effects, socio-economic impacts, and cultural resources and archeological values. (MHR)

37980 (UT/CES-CP—10(Vol.2), pp 546-590) **Environmental baseline monitoring in the area of General Crude Oil/Department of Energy Pleasant Bayou number 1: a geopressured-geothermal test well, 1978.** Gustavson, T.C. (Univ. of Texas, Austin); Dorman, J.; Sorrells, G.G.; Wilson, L.;. Jun 1980.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

The objectives of baseline monitoring studies in the vicinity of the Pleasant Bayou # 1 test well are to determine: (1) if natural subsidence is occurring, (2) air and water quality prior to geothermal fluid production, and (3) the level of noise pollution as a result of the drilling operation. Natural subsidence in the vicinity of the test well occurs at a mean rate of 8.8mm (0.029 ft) per year. For several stations, subsidence has ranged from 0.119 to 0.373 m (0.391 to 1.224 ft) since 1942. Microseismic monitoring in the vicinity of Pleasant Bayou # 2 indicates that there is no evidence of naturally occurring seismic activity of local magnitudes in excess of 0.25 within 4 km (2.5 mi) of the test well site. Air quality at Pleasant Bayou # 2 was monitored for particulates, sulfur dioxide, methane, and hydrogen sulfide. National ambient standards for particulates and sulfur oxides were not exceeded during 1978. The water chemistry of Chocolate Bayou in the vicinity of the test well is highly variable because mixing with marine waters of West Bay occurs in this part of the bayou. Analyses of shallow ground water in the vicinity of the test well indicate only a minor influence from mixing with salt water. Noise surveys in the vicinity of Pleasant Bayou # 1 indicate baseline noise levels of approximately 45 to 50 dB.

37981 (UT/CES-CP—10(Vol.2), pp 591-834) **Environmental analysis of geopressured geothermal prospect areas, DeWitt and Colorado Counties, Texas.** Badger, E.; Reeder, F.; Gustavson, T.C. (Univ. of Texas, Austin). Jun 1980.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

Environmental data including structural geology, substrate lithology, soils, natural hazards, water resources, biological assemblages, cultural resources, meteorological data, and regulatory considerations have been compiled and analyzed for two Wilcox Formation geopressured geothermal prospect areas. The Cuero prospect area in DeWitt County and the Eagle Lake prospect area in Colorado County each comprise approximately 218 km^2 (85 mi^2). Analysis of the environmental data, within the spatial limitations set by subsurface reservoir conditions, has allowed recognition of areas within each prospect area that are environmentally most suitable as sites for geopressured geothermal test wells. General environmental concerns that apply to both areas include potential accidental brine spills which could impact water resources and potential subsidence and faulting which could damage man-made structures. The Eagle Lake prospect area includes the town of Eagle Lake and is an area of heavy rice production. Rice requires precisely controlled water depths during irrigation. Thus, either accidental brine spills or subsidence could result in substantial impacts. Furthermore, the northeastern portion of the Eagle Lake area is one of the last remaining habitats of the Attwater Prairie chicken. The range of this endangered species includes both riceland in the northeastern portion of the prospect area and the Attwater Prairie Chicken National Wildlife Refuge. The western limit of the Eagle Lake prospect includes Eagle Lake, which supports a large population of the endangered American alligator. In the Cuero prospect area there are a few areas of valuable uses or biological resources.

37982 (UT/CES-CP—10(Vol.2), pp 972-999) **Subsurface disposal of geopressured fluids: potential geologic and operational problems with recommendations for disposal system testing.** Bachman, A.L. (Louisiana State Univ., Baton Rouge); Smith, C.G. Jr. Jun 1980.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

The results of the Workshop on Subsurface Disposal of Geopressured Fluids held at Louisiana State University, March 6-7, 1979 are reported. The LSU Workshop was the first to specifically address, in a group discussion format, the potential geologic and operational problems of subsurface disposal of geopressured fluids. The participants represented a wide range of expertise and included the major industry representatives and researchers in the field. The conclusions and recommendations of this group are discussed in this paper in three areas: (1) potential hydrogeologic and fluid/formation compatibility problems; (2) operational factors; and (3) the potential for fluid migration. Also described is the disposal system testing program that was developed as a result of issues raised during the Workshop.

37983 (UT/CES-CP—10(Vol.3), pp 1389-1413) **Comparison of six geopressured-geothermal prospect areas in the Louisiana Gulf Coast region on the basis of potential environmental impacts.** Newchurch, E.J. (Louisiana State Univ., Baton Rouge); Van Sickle, V.R.; Bachman, A.L.; Bryan, C.F.; Harrison, D.P.; Muller, R.A.; Smith, C.G. Jr. Jun 1980.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

A preliminary environmental assessment was made of six geopressured-geothermal prospect areas in the Louisiana Gulf Coast region as follows: South Johnson's Bayou, Sweet Lake, Rockefeller Refuge, Southeast Pecan Island, Atchafalaya Bay, and Lafourche Crossing. An attempt was made to determine, for each prospect area, whether the three-year reservoir testing program proposed by DOE would be likely to result in significant detrimental environmental effects. Baseline data for each prospect area were compiled from existing sources, and trade-offs among the prospects in terms of potential impacts were assessed. This assessment was made on the basis of the nature and extent of the proposed testing activities, in view of the environmental characteristics of each prospect area as regards land use, geology and geohydrology, air quality, water resources and quality, ecological systems, and natural hazards. Based on this study, it is believed that the test program activities, because they are so small in scale, will not result in major adverse impacts. No prospect area, with the possible exception of Rockefeller Refuge, needs to be excluded from consideration for the test well program.

37984 (UT/CES-CP—10(Vol.3), pp 1414-1434) **Environmental issues of geopressured resource development in Louisiana: integrating different goals and viewpoints.** Newchurch, E.J.; Bachman, A.L.; Bryan, C.F.; Harrison, D.P.; Muller, R.A.; Wilcox, R.E. (Louisiana State Univ., Baton Rouge). Jun 1980.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

An assessment of the key environmental issues of geopressured resource development in south Louisiana is described. Priorities were assigned on the basis of seven criteria, the application of which reflects the differing goals and viewpoints of regulatory agencies and industry. Underlying the entire assessment is the particular attention paid to two factors: (1) the large scale of geopressure operations which is the characteristic unique to geopressured resource development relative to the usual oil and gas field experience; and (2) the regulatory and legal framework of environmental issues. The application of the first factor represents the goal of preserving environmental quality; the second, industry's point of view. Environmental issues are assigned priorities as follows: (1) high priority - subsidence, fluid disposal, and surface disruption in wetland areas; (2) medium priority - accidentaal spills; and (3) low priority - air quality and noise impacts, induced seismicity and fault activation, and natural hazards.

37985 **Geothermal environmental seminar-'78.** Tucker, F.L.; Tanner, L.R. (eds.). Clearlake Oaks, CA; Lake County Printing (1978). 360p. (CONF-780572—).

From Geothermal seminar; Sacramento, CA, USA (9 May 1978).

Thirty-seven papers are included. Two were abstracted for EDB previously. Abstracts were prepared for the remaining thirty-five. (MHR)

37986 **DOE geothermal environmental overview program.** Jackson, C.D. (Dept. of Energy, San Francisco, CA). pp 1-13 of Geothermal environmental seminar-'78. Tucker, F.L.; Tanner, L.R. (eds.). Clearlake Oaks, CA; Lake County Printing (1978).

From Geothermal seminar; Sacramento, CA, USA (9 May 1978).

The role of DOE in assessing the environmental cost of geothermal energy development is presented. An environmental assessment approach based on local participation is described. (MHR)

37987 **Status of GRIPS program.** Hickey, J.H. pp 39-42 of Geothermal environmental seminar-'78. Tucker, F.L.; Tanner, L.R. (eds.). Clearlake Oaks, CA; Lake County Printing (1978).

From Geothermal seminar; Sacramento, CA, USA (9 May 1978).

GRIPS is an acronym for the Geothermal Resource Impacts Projection Study. The program was extended to cover the four-county area identified as the Geysers-Calistoga KGRA, i.e., Sonoma, Lake, Napa, and Mendocino Counties. The objectives and activities of GRIPS are reviewed briefly. (MHR)

37988 **Mufflers to abate noise and particulate emissions from geothermal development operations.** Whitescarver, O.D. pp 106-117 of Geothermal environmental seminar-'78. Tucker, F.L.; Tanner, L.R. (eds.). Clearlake Oaks, CA; Lake County Printing (1978).

From Geothermal seminar; Sacramento, CA, USA (9 May 1978).

Extensive work at The Geysers geothermal project has resulted in development of operating practices and equipment which control noise and particulate emissions. Major improvements have occurred in air drilling operations and overall field operations. The usual sound energy level measured at a monitoring station at The Geysers is Leq_{24} 55 with occasional excursions up to Leq_{24} 65. High volume air sampler studies indicate particulates in the ambient air at The Geysers are far less than allowed by state standards.

37989 **Acid rain study.** Ebbeson, H. pp 157-164 of Geothermal environmental seminar-'78. Tucker, F.L.; Tanner, L.R. (eds.). Clearlake Oaks, CA; Lake County Printing (1978).

From Geothermal seminar; Sacramento, CA, USA (9 May 1978).

The precipitation in the Geysers area of Lake County was studied to determine if the precipitation in the area was being made acidic from H_2S and SO_2 emissions from the Geysers geothermal field. The sampling mechanism design consisted of a 6- to 8-inch funnel (plastic) with polyvinyl tubing leading into a one-quart capacity container. A loop was put in the sample line to prevent any runoff from the supports from draining into the container. It appears that the rain at the sampling stations is not being made acidic by the ambient H_2S during the rain event. (MHR)

37990 **Effects of air pollutants on vegetation.** Hill, A.C. pp 165-169 of Geothermal environmental seminar-'78. Tucker, F.L.; Tanner, L.R. (eds.). Clearlake Oaks, CA; Lake County Printing (1978).

From Geothermal seminar; Sacramento, CA, USA (9 May 1978).

The mechanisms by which air pollutants affect plants are described. The specific effects of fluorides and sulfur dioxide as examples of toxic air pollutants are discussed. (MHC)

37991 **Remote sensing and environmental monitoring.** Frei, W. (Univ. of Southern California, Marina de Rey). pp 170-177 of Geothermal environmental seminar-'78. Tucker, F.L.; Tanner, L.R. (eds.). Clearlake Oaks, CA; Lake County Printing (1978).

From Geothermal seminar; Sacramento, CA, USA (9 May 1978).

Modern remote sensing techniques, coupled with computer analysis, provide a new low cost means of monitoring the environment over relatively large areas. The basic technological advances now offer the capability to detect negative environmental impacts at an early stage. Applied to geothermal energy developments, this capability could prove invaluable in providing greatly increased lead time in the case of emerging negative effects. The state of the art in remote sensing is reviewed as it applies to environmental monitoring. Results from ongoing research activities illustrate the potentials of some of the newest techniques, and show how they could be integrated into a low-cost routine environmental monitoring program.

37992 **Hydrogen sulfide abatement during geothermal steam drilling.** Castrantas, H.M.; Hampshire, L.R. pp 178-188 of Geothermal environmental seminar-'78. Tucker, F.L.; Tanner, L.R. (eds.). Clearlake Oaks, CA; Lake County Printing (1978).

From Geothermal seminar; Sacramento, CA, USA (9 May 1978).

Environmental restrictions during drilling of geothermal steam wells in The Geysers require that atmospheric hydrogen sulfide levels be reduced. In 1976, simultaneous spray injection of hydrogen peroxide and sodium hydroxide in a 45 kg per hour (100 pound/hr) geothermal steam flow was found to effectively abate hydrogen sulfide. From this, several full-scale tests were run during actual drilling operations, and a wide range of variables were investigated. Up to 98% hydrogen sulfide abatement was achieved using the hydrogen peroxide-sodium hydroxide system. The success of these tests led to construction of a portable abatement unit now in routine use in The geysers.

37993 Upstream abatement: a summary. Brown, F.C.; Harvey, W.W.; Warren, R.B. (EIC Corp., Newton, MA). pp 196-213 of Geothermal environmental seminar-'78. Tucker, F.L.; Tanner, L.R. (eds.). Clearlake Oaks, CA; Lake County Printing (1978).

From Geothermal seminar; Sacramento, CA, USA (9 May 1978).

The essential features of the EIC copper sulfate process for the removal of H_2S from geothermal steam and the program undertaken to support its development are described. The process has been shown to be capable of achieving very high degrees of H_2S removal under turbine upstream conditions. A system has been designed which will demonstrate all operations in the process at a near commercial, 5 MW scale. The final phase of a 3-phase, 4-year program is about to begin, during which the process will be demonstrated in a 6 to 9-month test campaign. A successful test will provide necessary data for the design of a full-size, commercial installation.

37994 Some important geothermal ecological issues. Leitner, P. pp 214-221 of Geothermal environmental seminar-'78. Tucker, F.L.; Tanner, L.R. (eds.). Clearlake Oaks, CA; Lake County Printing (1978).

From Geothermal seminar; Sacramento, CA, USA (9 May 1978).

The recent expansion of geothermal industry activities within The Geysers-Calistoga Known Geothermal Resource Area has generated serious concern about possible impacts on both natural and agricultural ecosystems. A number of known and potential ecological impacts were identified and evaluated at the Ecosystem Quality Workshop recently sponsored by Lawrence Livermore Laboratory and the Geothermal Resource Impact Projection Study (GRIPS). These included land use conversion, stream sedimentation, accidental spills of hazardous materials and vegetation stress due to boron emissions in cooling tower drift. Careful siting of geothermal facilities to avoid sensitive environmental features can minimize ecosystem damage. Appropriate use of emissions control technology and development of more effective mitigation measures should further reduce impacts. Finally, management programs to improve and enhance the status of existing natural resources could contribute to greater acceptance of geothermal development.

37995 Variance from certain hydrogen sulfide air pollution regulations at Geysers, California. pp 222-228 of Geothermal environmental seminar-'78. Tucker, F.L.; Tanner, L.R. (eds.). Clearlake Oaks, CA; Lake County Printing (1978).

From Geothermal seminar; Sacramento, CA, USA (9 May 1978).

The consequences of a variance from certain hydrogen sulfide (H_2S) emission standards at The Geysers geothermal area are discussed.

37996 Biological effects of H_2S on mammals. Murphy, J. pp 229-233 of Geothermal environmental seminar-'78. Tucker, F.L.; Tanner, L.R. (eds.). Clearlake Oaks, CA; Lake County Printing (1978).

From Geothermal seminar; Sacramento, CA, USA (9 May 1978).

Hydrogen sulfide effects upon humans are reviewed: odor, eye irritation, death from anoxia, and chronic effects. Research on effects on animals and incidents of every production hazards are described. (MHR)

37997 Ambient air quality standards. Moyer, N. pp 234-239 of Geothermal environmental seminar-'78. Tucker, F.L.; Tanner, L.R. (eds.). Clearlake Oaks, CA; Lake County Printing (1978).

From Geothermal seminar; Sacramento, CA, USA (9 May 1978).

Hydrogen sulfide odor, physiological response, and vegetation damage are tabulated related to specified concentrations. The threshold odor concentration for hydrogen sulfide as determined by a panel is shown. The standard for hydrogen sulfide is .03 ppM for one hour. The method of measurement, the relationship between ambient concentrations of hydrogen sulfide and the standard, and sources of H_2S are discussed. (MHR)

37998 Geysers SF_6 tracer results. Smith, T.B.; Knuth, W.R.; Giroux, H.D. (Meteorology Research, Inc., Altadena, CA). pp 240-255 of Geothermal environmental seminar-'78. Tucker, F.L.; Tanner, L.R. (eds.). Clearlake Oaks, CA; Lake County Printing (1978).

From Geothermal seminar; Sacramento, CA, USA (9 May 1978).

A series of tracer tests were carried out in which known amounts of an inert gas (SF_6) were released from potential source areas and sampled downwind at a variety of locations to aid in prediction of downwind H_2S concentrations. Continuous releases were made over periods of 2 to 5 hours. Hourly sampling was conducted at 20 locations downwind. Instantaneous grab samples (syringes) were also obtained on a mobile basis in areas of expected impact in order to obtain more detail in the concentration patterns. A total of 15 tracer releases were carried out in the fall of 1977. Results from five of these releases are shown. (MHR)

37999 Health effects of hydrogen sulfide. Holtzer, R.L. pp 256-260 of Geothermal environmental seminar-'78. Tucker, F.L.; Tanner, L.R. (eds.). Clearlake Oaks, CA; Lake County Printing (1978).

From Geothermal seminar; Sacramento, CA, USA (9 May 1978).

Effects of low-level exposure to hydrogen sulfide are discussed. The lack of data on exposure to low concentrations of hydrogen sulfides and possible symergistic effects is mentioned. (MHR)

38000 How OSHA standards for hydrogen sulfide are established. George, H. pp 261-263 of Geothermal environmental seminar-'78. Tucker, F.L.; Tanner, L.R. (eds.). Clearlake Oaks, CA; Lake County Printing (1978).

From Geothermal seminar; Sacramento, CA, USA (9 May 1978).

Previous methods of establishing standards are reviewed. Organizational charts and criteria for standards adoption in California are presented. (MHR)

38001 Rough terrain modeling concepts and precautions. Henderson, D. pp 264-270 of Geothermal environmental seminar-'78. Tucker, F.L.; Tanner, L.R. (eds.). Clearlake Oaks, CA; Lake County Printing (1978).

From Geothermal seminar; Sacramento, CA, USA (9 May 1978).

The results of a poll of the audience to a panel discussion on modelling in complex terrain on which model to use for a sample problem are given. The following classes of models are discussed: Gaussian, numerical, and physical. (MHR)

38002 Cobb Valley rough terrain: modeling results. Sklarew, R.C.; Tran, K.T. (Form and Substance, Inc., Westlake Village, CA). pp 271-305 of Geothermal environmental seminar-'78. Tucker, F.L.; Tanner, L.R. (eds.). Clearlake Oaks, CA; Lake County Printing (197[illegible]).

From Geothermal seminar; Sacramento, CA, USA (9 May 1978).

The extensions, testing, and use of the FAS (Form and Substance, Inc.) air quality model, IMPACT, is described. An example of the region and data used in these applications is described. Results of NEWEST 1 wind fields and of FAS/IMPACT calculated concentrations are presented. The model applicability and recommendations for future uses are discussed. (MHR)

38003 Geysers ambient air quality. Ruff, R.E. (SRI International, Menlo Park, CA). pp 306-317 of Geothermal environmental seminar-'78. Tucker, F.L.; Tanner, L.R. (eds.). Clearlake Oaks, CA; Lake County Printing (1978).

From Geothermal seminar; Sacramento, CA, USA (9 May 1978).

The SRI International monitoring network has been in operation for over two years. Hourly averages of hydrogen sulfide concentrations are briefly summarized as they relate to the State (California) ambient air quality standard. Also, the types of data analysis reported to the network sponsors on a quarterly basis are described.

38004 Data quality assurance program. Cher, M. (Rockwell International, Newbury Park, CA). pp 318-328 of Geothermal environmental seminar-'78. Tucker, F.L.; Tanner, L.R. (eds.). Clearlake Oaks, CA; Lake County Printing (1978).

From Geothermal seminar; Sacramento, CA, USA (9 May 1978).

A description is given of the way a quality assurance program was developed in cooperation with EPA for data of energy related monitoring activities in the Western United States. (MHR)

38005 Air quality as the limiting factor on development of the Geysers geothermal resources. Joyce, L.; Fontes, R.A. pp 334-344 of Geothermal environmental seminar-'78. Tucker, F.L.; Tanner, L.R. (eds.). Clearlake Oaks, CA; Lake County Printing (1978).

From Geothermal seminar; Sacramento, CA, USA (9 May 1978).

An air quality problem exists at The Geysers, California, as a result of hydrogen sulfide (H_2S) emissions from geothermal power generation. The policy and legal issues engulfing the air quality problem and efforts to mitigate the problem are examined. Estimates are made of the air quality impacts of future generation capacity based on utility electricity supply plans as submitted to California Energy Commission (CEC). The status of current and developing H_2S abatement technologies is examined for availability and technical characteristics. Analysis is provided on the prospect and consequences of inadequate control of H_2S emissions. H_2S control efficiencies of less than 95% may ultimately be ineffective if full field development is to be achieved at The Geysers.

GEOTHERMAL POWER PLANTS

38006 (DOE/EV/03201—T1) **Water assessment report, section 13(b).** (Water Resources Council, Washington, DC (USA)). Sep 1980. Contract AI01-76EV03201. 37p. NTIS, PC A03/MF A01.

An assessment is presented of water requirements and water supply availability for a proposed Geothermal Binary Demonstration Electric Generation Project near Heber, California. The following topics are discussed: principal findings, project description, water supply and availability, and effects of the project. (MHR)

38007 **Roosevelt hot springs development.** Rogers, H.I. (Rogers Engineering Co, Inc., San Francisco, CA). pp 149-156 of Geothermal environmental seminar-'78. Tucker, F.L.; Tanner, L.R. (eds.). Clearlake Oaks, CA; Lake County Printing (1978).

From Geothermal seminar; Sacramento, CA, USA (9 May 1978).

Roosevelt Hot Springs, near Milford, Utah, is currently the site of a geothermal power project development. This development will be the first commercial electric power plant generating from a hydrothermal resource in the United States. Other hydrothermal resources are generating electric power in Iceland, El Salvador, Mexico, Japan and, in the near future, the Phillippines. The project I will be discussing today is a combined project among Phillips Petroleum Company, Rogers International and Utah Power and Light Company. The three parties are currently negotiating contracts for the purchase and sale of geothermal fluids and the purchase and shale of electrical energy. The anticipated commercial operation date of the geothermal electric power plant is now scheduled for June 1980.

DESIGN AND OPERATION

38008 (UT/CES-CP—10(Vol.2), pp 875-903) **Conceptual design studies of energy conversion plants using geopressured fluid.** Lamb, J.P.; Polansky, G.F.; Bradley, S.P. (Univ. of Texas, Austin). Jun 1980.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

Development of system simulation models and selected results that predict performance of future power plants in Texas are reviewed. Predictions are categorized as follows: (1) wellbore results which demonstrate relative unimportance of heat loss to the geological formation and importance of potential scale growth to power generation; (2) wellbore-reservoir simulations which illustrate effects of depletion rate and hence how uncertainties in initial pressure, temperature, and total aquifer volume can affect wellhead fluid conditions; (3) conversion plant performance estimates which include (a) influence of hydraulic recovery, (b) choice of thermal recovery system (flash or binary), (c) choice of binary working fluid (propane or isobutane), (d) potential performance gains from variable condensing conditions, and (e) extreme importance of maximizing gas recovery. Discussion emphasizes both design and economic compromises.

POWER PLANT SYSTEMS AND COMPONENTS

REFER ALSO TO CITATION(S) 37977, 38032

38009 (COO—3904-1, pp 73-85) **Materials selection for geothermal steam turbines.** Cameron, J.A. (Elliott Co., Jeannette, PA). 1978.

From Symposium on materials in geothermal energy systems; Austin, TX, USA (23 May 1978).

The following materials properties and characteristics are discussed: tensile properties, modules of elasticity, corrosion resistance, erosion resistance, fatigue strength, coefficient of thermal expansion, susceptibility to brittle fracture (toughness), material damping, specific heat, thermal conductivity, hardenability, and weldability. Materials used for turbines using steam from fossil fuel fired boilers are described. (WHR)

GEOTHERMAL ENGINEERING

DRILLING TECHNOLOGY AND WELL HARDWARE

REFER ALSO TO CITATION(S) 37946, 38019

38010 (COO—3904-1, pp 23-43) **Nondestructive evaluation technique for detecting the incipient failure of drill pipes used in geothermal well drilling.** Hochrein, A.A. Jr.; Yeager, L.L. (DAEDALEAN ASSOCIATES, Inc., Woodbine, MD). 1978.

From Symposium on materials in geothermal energy systems; Austin, TX, USA (23 May 1978).

A unique nondestructive evaluation technique was developed which utilizes the phenomenon of internal friction in materials and identifies changes in the specific damping capacity as a function of the integrity of the material being tested. Specifically, geothermal drill pipes used in well drilling have been tested utilizing the internal friction nondestructive evaluation (IF-NDE) technique. Various conditional operating parameters such as hydrogen sulfide embrittlement, corrosion fatigue, and stress corrosion cracking were correlated to the useful life of drill pipes as identified by the IF-NDE technique. The analysis of data derived from numerous tests conducted in the field indicate that the difference failure mechanisms each have their own characteristic decay associated with failure in the drill pipe. Further, the internal friction measurement which is identified as the specific damping capacity of the various drill pipes increases as the drill pipes progress toward ultimate failure.

38011 (COO—3904-1, pp 44-72) **Materials problems encountered inSperry's downhole geothermal pump program.** Matthews, H.B.; McBee, W.D. (Sperry Research Center, Sudbury, MA). 1978.

From Symposium on materials in geothermal energy systems; Austin, TX, USA (23 May 1978).

The following are covered: the Sperry pumping system concept, the turbine pump unit, the surface system, the down-hole pipe string, the test wellhead equipment, the brine transport system, field test conditions, and material and mechanical problems encountered during field test. (MHR)

38012 (DOE/ET/28460—4) **Investigation and evaluation of geopressured-geothermal wells. Final report, Tenneco Fee N No. 1 Well Terrebonne Paris, Louisiana.** Dobson, R.J.; Hartsock, J.H.; McCoy, R.L.; Rodgers, J.A. (Gruy Federal, Inc., Houston, TX (USA)). Sep 1980. Contract AC08-77ET28460. 123p. NTIS, PC A06/MF A01.

The reservoir conditions that led to the choice of this well as the fifth well of opportunity are described as well as the attempts to complete the well for high-volume brine production. Individual opinions concerning underlying and conributing causes for the liner failure which aborted the completion attempt are included. (MHR)

38013 (PB—80-126246) **Geothermal down-well pumping system. Phase I, laboratory test report.** (Sperry Research Center, Sudbury, MA (USA)). 10 Nov 1975. 35p. NTIS, PC A03/MF A01.

A technical problem in the exploitation of hot water geothermal energy resources is down well pumping to prevent mineral precipitation, improve thermal efficiency, and enhance flow. A novel approach to this, based on transferring about 5% of the available energy in the pumped fluid to a down-well-boiler-turbine-pump assembly, was conceived and is described here. Phase 1 of a program to cover the design, fabrication, and laboratory testing of the geothermal down-well turbine-pump unit (TPU) has been completed and the laboratory results for the entire TPU are presented. They indicate that the basic design approach is sound and no major difficulties were experienced. The overall performance exceeded the design goals.

38014 (SAND—79-7122) **Development of drilling foams for geothermal applications.** McDonald, W.J.; Remont, L.J.; Rehm, W.A.; Chenevert, M.E. (Maurer Engineering, Inc., Houston, TX (USA); Chenevert and Associates, Houston, TX (USA)). Jan 1980. Contract AC04-76DP00789. 180p. NTIS, PC A09/MF A01.

The use of foam drilling fluids in geothermal applications is addressed. A description of foams - what they are, how they are used, their properties, equipment required to use them, the advantages and disadvantages of foams, etc. - is presented. Geothermal applications are discussed. Results of industry interviews presented indicate significant potential for foams, but also indicate significant technical problems to be solved to achieve this potential. Testing procedures and results of tests on representative foams provide a basis for work to develop high-temperature foams.

38015 (UT/CES-CP—10(Vol.1), pp 200-216) **Completion and testing of No. 2 Pleasant Bayou well.** Stevens, J.E.; Clark, J.D. Jun 1980.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

Beginning with preparation on July 8, 1979 (between 14,704 ft and 14,684 ft), the well was subjected to a 24-hour production test which is described in detail and interpreted via the wellhead pressure variations. Initial brine chemical analysis indicated a dissolved gas content of 21 ft^3/bbl. Primary constituents of the gas were methane (84%), ethane (3%), and carbon dioxide (10%). The brine contained dissolved solids at a total concentration of 156,000 Mg/l. The planned one-year test program is also described which will include an initial phase limited to 20,000 bbl/day flow followed by installation of more extensive surface equipment which will allow the maximum flow rate to be increased to 40,000 bbl/day. It is anticipated that 4,700,000 bbl of brine will be withdrawn during the dynamic portion of these tests.

38016 (UT/CES-CP—10(Vol.3), pp 1200-1224) **Analyses of test results from the Fairfax Foster Sutter No. 2.** McCoy, R.L.; Hartsock, J.H. (Gruy Federal, Inc., Houston, TX). Jun 1980.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

The Fairfax Foster Sutter No. 2 Well, located in the East Franklin area of St. Mary Parish, Louisiana, is the first successful test of a geopressured-geothermal aquifer under the Well-of-Opportunity program. The section tested was the MA-6 sand of lower Miocene age which has produced large quantities of gas from the adjacent but structurally separated Garden City Field. In Garden City this sand is characterized by pressure gradients of up to 0.94 psi/ft and reservoir temperatures in the 290°F (143°C) range. In the subject well the observed temperature was 270°F (132°C) and the measured pressure gradient was 0.77 psi/ft. The net sand thickness of the tested interval was 58 ft with an effective porosity of 19 percent. The temperature and pressure encountered were on the threshold of the limitations of the surface-recording bottomhole pressure gauge and particularly the single-conductor cables on which the gauges were run. In general, the gas solubility (22.8 scf/bbl) was as expected for the temperature, pressure, and salinity of the brine. The produced water was more saline than expected (160,000 mg/l). The results of the analyses of the production data, along with the geological and petrophysical implications, are presented. (MHR)

FLUID TRANSMISSION

REFER ALSO TO CITATION(S) 38032

CORROSION, SCALING, AND MATERIALS DEVELOPMENT

REFER ALSO TO CITATION(S) 38010, 38011

38017 (COO—3904-1) **Geothermal systems materials: a workshop/symposium.** (Radian Corp., Austin, TX (USA)). 1978. Contract EG-77-C-04-3904. 332p. (CONF-7805211—). NTIS, PC A15/MF A01.

From Symposium on materials in geothermal energy systems; Austin, TX, USA (23 May 1978).

Sixteen papers are included. A separate abstract was prepared for each. Summaries of workshops on the following topics are also included in the report: non-metallic materials, corrosion, materials selection, fluid chemistry, and failure analysis. (MHR)

38018 (COO—3904-1, pp 5-14) **Material progress at Cerro Prieto, Mexico.** Mercado, A.M. (Comision Federal de Electricidad, Cerro Prieto, Mexico). 1978.

From Symposium on materials in geothermal energy systems; Austin, TX, USA (23 May 1978).

A brief general description is presented about the principal problems observed on the materials used in the Cerro Prieto geothermal project. These include those problems that have been observed in drill pipes, well casing separation equipment and conduction pipes for geothermal water and steam as well as the problems observed in geothermal power plant materials.

38019 (COO—3904-1, pp 15-22) **Materials selection for sealed and unsealed rolling cone geothermal bits.** Hendrickson, R.R.; Jones, A.H.; Winzenried, R.W. (Terra Tek, Inc., Salt Lake City, UT). 1978.

From Symposium on materials in geothermal energy systems; Austin, TX, USA (23 May 1978).

Field and laboratory testing of the final generation of unsealed bits (MK-III) should allow the unsealed bit program to enter the commercialization phase. Extensive seal testing has shown that conventional bit seals are near the state-of-the-art for high-temperature service. However, it may be possible to raise the seal's temperature limitations by the use of a more compatible lubricant. Non-elastomeric seals may provide a much greater improvement, but face size limitations and corrosion problems in addition to the heat, abrasiveness and mechanical eccentricities. Improvements in seal, or seal/lubricant temperature limitations can benefit all sealed bit applications by permitting higher RPM/penetration rate as well as the higher temperature ceiling.

38020 (COO—3904-1, pp 86-110) **Summary of first 12 months progress on geothermal elastomeric materials program.** Hirasuna, A.R. (L'Garde, Inc., Newport Beach, CA). 1978.

From Symposium on materials in geothermal energy systems; Austin, TX, USA (23 May 1978).

A three-step graduated testing and evaluation of material candidates is described. The steps are screening tests, simulation of downhole conditions, and downhole testing. It appears that EPDM holds the most promise of the elastomers formulations developed and tested thus far. (MHR)

38021 (COO—3904-1, pp 111-118) **L'Garde geothermal packer elastomers development program: recent developments, October 1978.** Hirasuna, A.R. (L'Garde, Inc., Newport Beach, CA). 1978.

From Symposium on materials in geothermal energy systems; Austin, TX, USA (23 May 1978).

The thermohydrochemical stability of some geothermal elastomers is shown. A qualitative description of the amount of extrusion experienced at various temperatures for each base elastomer is presented. (MHR)

38022 (COO—3904-1, pp 119-123) **Development of a cavitating descaling technique for geothermal scale removal.** Hochrein, A.A. Jr.; Graham, F. (DAEDALEAN ASSOCIATES, Inc., Woodbine, MD). 1978.

From Symposium on materials in geothermal energy systems; Austin, TX, USA (23 May 1978).

Extensive research was conducted in the field of cavitation erosion. Data has been gathered concerning the cause, prevention, control and damage resulting from this cavitation phenomena. Resulting from this research has been: 1) an understanding of the damaging effects of cavitation erosion and 2) an understanding of the conditions necessary to develop and control cavitation. From this understanding of the development and control of cavitation erosion DAI has developed a high pressure water jet system (CONCAVER) utilizing the phenomena of controlled cavitation erosion as a working tool for cleaning and cutting applications.

38023 (COO—3904-1, pp 124-177) **Thermodynamic analysis of corrosion phenomena in high salinity geothermal brines.** Macdonald, D.D.; Syrett, B.C. (SRI International, Menlo Park, CA). 1978.

From Symposium on materials in geothermal energy systems; Austin, TX, USA (23 May 1978).

Recent studies are reviewed of the corrosion potential and cyclic voltammetric behavior of AISI 1010 carbon steel, E-Brite 26-1 stainless steel, AISI 316L stainless steel, Haynes Alloy 20 Mod, Carpenter 20 Cb-3, Inconel Alloy 625, Hastelloy Alloy G, Hastelloy Alloy C-276, Titanium 50A (ASTM B265 Gr. 2), and TiCode 21 in a sulfide-free high-salinity geothermal brine taken from a producing well located in the Imperial Valley in Southern California. Potential-pH diagrams for the component metal (Fe, Ni, Cr, Ti)-brine systems at temperatures of 25°C and 250°C are used to rationalize the corrosion potentials and the oxidation and reduction peak potentials for the alloys observed by cyclic voltammetry. Potential-pH diagrams for iron and nickel in high salinity brine at 25°C and 250°C containing 10 ppM of total dissolved sulfide are reported. These diagrams are used to analyze the general features of the thermodynamic behavior of iron and nickel in high temperature sulfide-containing geothermal systems. (MHR)

38024 (COO—3904-1, pp 178-193) **Corrosion testing in a multiple-stage flash system.** McCright, R.D.; Garrison, R.E. (Univ. of California, Livermore). 1978.

From Symposium on materials in geothermal energy systems; Austin, TX, USA (23 May 1978).

Corrosion rate results from a 720-hour exposure period to geothermal brine acidified to pH4 are discussed. The corrosion tests were performed in a four-stage flash system so that results obtained at different temperatures could be compared. Carbon steel and alternate construction materials were used as test specimens. Results indicate that carbon steel corrodes excessively (more than 50 mils/year) at temperatures above 150°C. Alternate construction materials (alloy steels) may be utilized under these conditions.

38025 (COO—3904-1, pp 194-242) **Hydrogen sulfide stress corrosion cracking in materials for geothermal power.** Troiano, A.R.; Hehemann, R.F. 1978.

From Symposium on materials in geothermal energy systems; Austin, TX, USA (23 May 1978).

Methods and results are reported for bent beam, C-ring, and smooth tensile bar tests of materials for use in geothermal environments. (MHR)

38026 (COO—3904-1, pp 243-244) **East Mesa Geothermal Component Test Facility.** Newman, K.L. (WESTEC Services, Inc., San Diego, CA). 1978.

From Symposium on materials in geothermal energy systems; Austin, TX, USA (23 May 1978).

The test facility, its funding, and well data are described briefly. (MHR)

38027 (COO—3904-1, pp 245-255) **Materials for use in corrosive geothermal brine environments.** McCawley, F.X.; Carter, J.P. (Bureau of Mines, College Park, MD). 1978.

From Symposium on materials in geothermal energy systems; Austin, TX, USA (23 May 1978).

Some of the laboratory and field corrosion tests conducted in both low- and high-salinity brines are presented. Some of the equipment failures due to corrosion and scaing that occurred during laboratory and field tests are also discussed. Laboratory studies included weight-loss, crevice, and pitting corrosion, stress-corrosion cracking, linear-polarization measurements, and corrosion attack of welded materials. The laboratory work was conducted in autoclaves

using high-salinity brines at a temperature of 232°C and a pressure of 450 psig. Materials were evaluated in both deaerated brines and in brines which contained O_2, CH_4, and CO_2 gases. Materials evaluated include 1020, 4130, COR-TEN[4] and Mariner steels; 316 L, 430, and E-Brite 26-1 stainless steels; commercially pure titanium, TiCode-12, Ti-0.2%Pd, Inconel 625, and Hastelloy C-276. Field corrosion tests were conducted on brine from the East Mesa (low salinity) and Salton Sea (high salinity) Imperial Valley geothermal fields. (MHR)

38028 (COO—3904-1, pp 256-260) **In-situ protection of metals against corrosion and scaling in hot brines.** Brummer, S.B. (EIC Corporation, Newton, MA). 1978.

From Symposium on materials in geothermal energy systems; Austin, TX, USA (23 May 1978).

A method to overcome both corrosion and scaling problems simultaneously is presented. It involves deposition of a thin (< 1 mil) layer of polymer onto the surface of the metal. Preliminary experiments have been carried out with the polymer films formed from phenols and certain aromatic amines on copper, various steels, and cupronickel. (MHR)

38029 (COO—3904-1, pp 261-284) **Polymer concrete materials for use in geothermal energy processes.** Kukacka, L.E. (Brookhaven National Lab., Upton, NY). 1978.

From Symposium on materials in geothermal energy systems; Austin, TX, USA (23 May 1978).

The feasibility of using polymer concretes as materials of construction in geothermal processes has been demonstrated and tests to determine the practicability are in progress. High temperature polymer concrete systems have been formulated and laboratory and field tests are being performed in brine, flashing brine, and steam at temperatures up to 500°F (260°C). Results are available from field exposures of up to 18 months in four geothermal environments. Good durability at temperatures > 392°F (200°C) is obtained with samples containing portland cement-silica sand aggregate. Based upon these results, potential applications for polymer concrete in geothermal processes have been identified and the effects of its use on the cost of electric power generation have been estimated. Reductions in the cost of power delivered to the distribution system of ~ 10% were calculated. Redesign of the plants for the optimum utilization of polymer concrete would be expected to result in greater savings.

38030 (COO—3904-1, pp 285-289) **Corrosion problems in Klamath Falls, Oregon.** Culver, G. (Oregon Institute of Technology, Klamath Falls, OR). 1978.

From Symposium on materials in geothermal energy systems; Austin, TX, USA (23 May 1978).

There are approximately 450 geothermal wells in Klamath Falls, used primarily for space heating of 500-550 homes. Most wells have downhole heat exchangers whose average useful life is approximately 14 years. Corrosion and failure problems primarily at the Oregon Institute of Technology are reviewed and discussed. (MHR)

38031 (UT/CES-CP—10(Vol.2), pp 848-874) **Electrochemical corrosion measurements in geothermal brines.** Eliezer, Z.; Pearsall, K.J.; Mecredy, H.E.; Tjong, S.C. (Univ. of Texas, Austin). Jun 1980.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

Electrochemical corrosion measurements on several types of structural materials were performed in both synthetic and natural brines. It has been found that the uniform corrosion rate is relatively low for all the materials tested (except the low carbon steel). The localized corrosion is very severe for the regular austenitic, martensitic, and ferritic stainless steels as well as for Inconel 600. No localized corrosion was seen on the low carbon 1018 steel. The two alloys identified in the text as 28 and 2205 showed excellent resistance to localized corrosion. The nature of the passivating film formed in brine on alloy 28 was identified by the Auger electron spectroscopy (AES) technique. It has been found, contrary to expectations, that the protective film is depleted of molybdenum and enriched in manganese. The possible effects of these findings on the development of new corrosion-resistant alloys for the geothermal industry are currently under study.

GEOTHERMAL RESERVOIR AND WELL PERFORMANCE

REFER ALSO TO CITATION(S) 37919, 37921, 37929, 37930, 37931, 37937, 37955, 37978

38032 (DOE/ET/27225—13) **Two-phase flow studies. Final report.** Kestin, J.; Maeder, P.F. (Brown Univ., Providence, RI (USA). Div. of Engineering). Aug 1980. Contract AC02-79ET27225. 15p. NTIS, PC A02/MF A01.

Progress on the following is reported: literature survey, design of two-phase flow testing facility, design of nozzle loop, thermophysical properties, design manual, and advanced energy conversion systems. (MHR)

38033 (LA-UR—80-2645) **Pressure losses in fracture-dominated reservoirs: the wellbore constriction effect.** Murphy, H. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 7p. (CONF-801123—1). NTIS, PC A02/MF A01.

From Geothermal Institute 1980 workshop; Aukland, New Zealand (Nov 1980).

Improved energy production from many types of energy reservoirs such as hot dry rock geothermal as well as hydraulically fractured oil, gas, and other geothermal reservoirs requires a better understanding of the fluid mechanics in the vicinity of the fracture-wellbore intersection. Typically, the aperture (smallest dimension) of a hydraulic fracture is only of the order of 1 mm (0.04 in.) so that reasonable energy production rates from geothermal systems require fairly large flow velocities within the fractures, particularly so as the wellbore-fracture intersection is approached. The high velocities and accelerations result in non-Darcian, often turbulent, flow and increased pressure losses. These flow phenomena were investigated experimentally for the simple case where the fracture plane and the wellbore drilling axis are orthogonal and the implication of these experimental results are examined by investigating the pressure losses in a hot dry rock reservoir.

38034 (LBL—5934) **Analysis of well tests with variable discharge.** Tsang, C.F.; McEdwards, D.G.; Narasimhan, T.N.; Witherspoon, P.A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1976. Contract W-7405-ENG-48. 9p. (CONF-761221—2). NTIS, PC A02/MF A01.

From 2. workshop on geothermal reservoir engineering; Stanford, CA, USA (1 Dec 1976).

The development of a general technique of analyzing well tests with variable flow rates is reported. The variable flow is approximated by a series of sequential straight line segments of arbitrary length and slope. (MHR)

38035 (LBL—11235) **History match simulation of Serrazzano geothermal reservoir.** Pruess, K.; Weres, O.; Schroeder, R.; Marconcini, R.; Neri, G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1980. Contract W-7405-ENG-48. 35p. NTIS, PC A03/MF A01.

The simulator SHAFT79 of Lawrence Berkeley Laboratory has been applied to field-wide distributed parameter simulation of the vapor-dominated geothermal reservoir at Serrazzano, Italy. Using a three-dimensional geologically accurate mesh and detailed flow rate data from 19 producing wells, a period of 15.5 years (from 1959 to 1975) has been simulated. The reservoir model used is based on field measurements of temperatures and pressures, laboratory data for core samples, and available geological and hydrological information. The main parameters determined (adjusted) during development of the simulation are permeabilities and much of the initial conditions. Simulated patterns of pressure decline show semi-quantitative agreement with field observations. The simulation suggests that there is cold water recharge and/or incomplete heat transfer from he rock due to fractures in the margins of the reservoir, and some steam flowing to the main well field originates from deep fractures rather than from boiling in the two-phase zones modeled. Simulation methodology and ambiguity of parameter determination is discussed.

38036 (UT/CES-CP—10(Vol.2), pp 1000-1030) **Reinjection of fluids into a producing geopressured reservoir.** Garg, S.K. (Systems, Science, and Software, La Jolla, CA). Jun 1980.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

A reservoir simulator (MUSHRM) was employed to examine the effects of reinjecting the processed brine on the long-term performance of a representative geopressured reservoir. These calculations indicate that reinjection can be used to substantially increase methane and brine production. The results suggest that power requirements for reinjection pumps can be met either by burning approximately two-thirds of the produced methane (which may in some cases negate the benefits of reinjection as far as methane production is concerned) or by using the heat of the produced brine (320°F) to generate electric power. Assuming that electric power produced from hot brine is used to reinject the processed fluids, it appears that reinjection is a viable production strategy for increasing methane recovery from some geopressured systems. The attractiveness of reinjection to recover methane increases with increasing formation permeability and decreasing formation compressibility.

38037 (UT/CES-CP—10(Vol.3), pp 1273-1326) **Ratio of produced gas to produced water from DOE'S Edna Delcambre No. 1 geopressured-geothermal aquifer gas well test.** Rogers, L.A.; Randolph, P.L. (Inst. of Gas Tech., Chicago, IL). Jun 1980.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

Efforts to match the observed gas/water production with computer simulation are described. Two models for the occurrence and production of gas in excess of that dissolved in the brine have been used. One model considers the gas to be dispersed in pores by

imbibition, and the other model considers the gas as a nearby free gas cap above the aquifer. The studies revealed that the dispersed gas model characteristically gave the wrong shape to plots of gas production on the gas/water ratio plots such that no reasonable match to the flow data could be achieved. The free gas cap model gave a characteristically better shape to the production plots and could provide an approximate fit to the data if the edge of the free gas cap is only about 400 feet from the well. Because the geological structure maps indicate the free gas cap to be several thousand feet away and the computer simulation results match the distance to the nearby Delcambre Nos. 4 and 4A wells, it appears that the source of the excess free gas in the test of the No. 1 sand may be from these nearby wells. The gas source is probably a separate gas zone and is brought into contact with No. 1 sand via a conduit around the No. 4 well. (MHR)

38038 **Hot water vs. dry steam reservoir assessment.** Campbell, D.A. pp 118-138 of Geothermal environmental seminar-'78. Tucker, F.L.; Tanner, L.R. (eds.). Clearlake Oaks, CA; Lake County Printing (1978).

From Geothermal seminar; Sacramento, CA, USA (9 May 1978).

The reservoir assessment goal of the geothermal reservoir engineer is to determine the producibility and magnitude of reserves. The engineering approaches used come from the petroleum and hydrology fields. Although differing in specific detail, there are no fundamental differences between the techniques used to assess hot water and dry steam resources. In practice, reserves and producibility in dry steam fields may be easier to assess adequately because they are less sensitive to economics and technology and they tend to have a significant production history. Intergranular pore space reservoirs can presently be assessed with greater confidence much earlier in the reservoir development than can fractured reservoirs. Three basic methods of reserve determination, i.e., volumetric, material/energy balance (including reservoir simulation), and decline curve, are reviewed and illustrated with successful examples of their application. A simple method for first order assessment of productivity is presented. The difficulties encountered in making these estimates prior to power plant operations on the basis of limited data are noted, with emphasis on the uncertainties of fractured reservoirs.

RESERVOIR STIMULATION AND EXTRACTION TECHNOLOGY

REFER ALSO TO CITATION(S) 37928

38039 (PB—80-127137) **Fluid flow through a large vertical crack in the earth's crust.** Weertman, J.; Chang, S.P. (Northwestern Univ., Evanston, IL (USA)). 1977. 23p. NTIS, PC A02/MF A01.

Modeling of fluid flow through vertical cracks for the purpose of extracting heat from hot, dry rock masses is described. A basic equation for the two-dimensional problem of fluid flow through a crack is presented and an appropriate solution found for the crack profile and stress intensity factors. The basic equation is a nonlinear Cauchy-singular integro-differential equation. Moderately simple formulas for the crack opening displacement and the effective pressure difference between the crack tips are derived. Two corrections, usually small in magnitude, are given. The results are valid for arbitrary vertical cracks, provided the fluid injection and removal points are not placed too close to the crack tips. For cracks of half widths greater than 50 meters with fluids flowing through them having the same viscosity and density of water, the crack profiles and stress intensity factors correspond essentialy to those of a fluid filled crack in which the fluid is stationary.

38040 (PB—80-128184) **Growth rate of a penny-shaped crack in hydraulic fracturing of rocks.** Abe, H.; Keer, L.M.; Mura, T. (Northwestern Univ., Evanston, IL (USA). Dept. of Civil Engineering). 1976. 25p. NTIS, PC A02/MF A01.

The deformation and growth of a crack, fractured hydraulically, is investigated when fluid is injected from an inlet into the crack at a constant flow rate. The total flow rate at the inlet is divided as follows: flow rate extracted from an outlet hole; fluid loss rate from the crack surface; and total fluid mass change in the crack. Two cases are considered: (1) inlet flow rate is initially greater than the sum of the outlet flow and fluid loss rates; and (2) the reverse holds true. Ranges are shown for which the crack attains stationary states for given inlet flow rate and outlet pressure. For these two cases reasonable outlet flow rates are obtained when the outlet pressure is less than or equal to the difference between the tectonic stress and the fluid head at the inlet. Results are expected to be of use in considerations of heat extraction from hot, dry rock.

DIRECT ENERGY UTILIZATION

REFER ALSO TO CITATION(S) 37889, 38030

38041 (DOE/ET/20501—T1) **Direct application of geothermal energy.** Reistad, G.M. (Oregon State Univ., Corvallis (USA); American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., New York). 1980. Contract AC01-78ET20501. 73p. NTIS, PC A04/MF A01.

An overall treatment of direct geothermal applications is presented with an emphasis on the above-ground engineering. The types of geothermal resources and their general extent in the US are described. The potential market that may be served with geothermal energy is considered briefly. The evaluation considerations, special design aspects, and application approaches for geothermal energy use in each of the applications are considered. The present applications in the US are summarized and a bibliography of recent studies and applications is provided. (MHR)

38042 (DOE/ET/28508—4) **Method for evaluating the potential of geothermal energy in industrial process heat applications.** Packer, M.B.; Mikic, B.B.; Meal, H.C., Guillamon-Duch, H. (Massachusetts Inst. of Tech., Cambridge (USA). School of Engineering). 1 May 1980. Contract AS02-78ET28508. 416p. NTIS, PC A18/MF A01.

A method is presented for evaluating the technical and economic potential of geothermal energy for industrial process heat applications. The core of the method is a computer program which can be operated either as a design analysis tool to match energy supplies and demands, or as an economic analysis tool if a particular design for the facility has already been selected. Two examples are given to illustrate the functioning of the model and to demonstrate that results reached by use of the model closely parallel those that have been determined by more traditional techniques. Other features of interest in the model include: (1) use of decision analysis techniques as well as classical methods to deal with questions relating optimization; (2) a tax analysis of current regulations governing percentage depletion for geothermal deposits; and (3) development of simplified correlations for the thermodynamic properties of salt solutions in water.

38043 (DOE/ID/12010—4) **Industrial application of geothermal energy in Southeast Idaho.** Batdorf, J.A.; McClain, D.W.; Gross, M.; Simmons, G.M. (Idaho State Office of Energy, Boise (USA)). Feb 1980. Contract FC07-79ID12010. 86p. NTIS, PC A05/MF A01.

Those phosphate related and food processing industries in Southeastern Idaho are identified which require large energy inputs and the potential for direct application of geothermal energy is assessed. The total energy demand is given along with that fractional demand that can be satisfied by a geothermal source of known temperature. The potential for geothermal resource development is analyzed by examining the location of known thermal springs and wells, the location of state and federal geothermal exploration leases, and the location of federal and state oil and gas leasing activity in Southeast Idaho. Information is also presented regarding the location of geothermal, oil, and gas exploration wells in Southeast Idaho. The location of state and federal phosphate mining leases is also presented. This information is presented in table and map formats to show the proximity of exploration and development activities to current food and phosphate processing facilities and phosphate mining activities. (MHR)

GEOTHERMAL DATA AND THEORY

PROPERTIES OF AQUEOUS SOLUTIONS

REFER ALSO TO CITATION(S) 37943

38044 (UT/CES-CP—10(Vol.3), pp 1225-1262) **Methane solubility in aqueous NaCl solutions at elevated temperatures and pressures.** Blount, C.W. (Idaho State Univ., Pocatello); Price, L.C.; Wenger, L.M.; Tarullo, M. Jun 1980.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

The solubility of methane in water and in various concentrations of aqueous NaCl solutions has been experimentally measured at a range of elevated temperatures and pressures. Increasing pressure and increasing temperature both result in an increase in the solubility of methane in water and in aqueous NaCl solutions. Increasing the NaCl concentration at constant temperature and pressure markedly decreases the solubility of methane. In log-log plots, methane solubility increases linearly with increasing pressure at constant temperature and constant NaCl concentration; it decreases linearly with increasing NaCl concentration at constant temprature and pressure. An empirical equation was derived from the solubility data using regression analysis. Using this equation, one can interpolate aqueous methane solubilities (to +-6 percent) for any given temperature over the range from 212° to 464°F, pressure from 2000 to 22,500 psi, and NaCl concentration from 0.3 to 25 weight percent.

PROPERTIES OF MINERALS AND ROCKS

REFER ALSO TO CITATION(S) 37922

38045 (UT/CES-CP—10(Vol.2), pp 1060-1080) **Preliminary creep analysis of rocks from the Pleasant Bayou wells.** Thompson, T.W.; Gray, K.E.; MacDonald, R.C.; Jogi, P.N. (Univ. of Texas, Austin). Jun 1980.

From 4. United States gulf coast geopressured-geothermal energy conference; Austin, TX, USA (29 Oct 1979).

Some cores retrieved from the Pleasant Bayou wells show pronounced time-dependent behavior. This time dependence is evident under both hydrostatic and deviatoric loading, and in drained and undrained tests. Preliminary models have been set up to analyze these preliminary data based on linear viscoelastic models. It will be shown that these models go some way towards describing the observed behavior, but that non-linearity must be accounted for. The significance of this nonelastic behavior to production and subsidence analysis is discussed.

WIND ENERGY

AVAILABILITY (CLIMATOLOGY)

38046 (DOE/CS/20160—01(Vol.1)) **Site insolation and wind power characteristics. Summary report.** Bray, R.E. (Northrop Services, Inc., Huntsville, AL (USA)). Aug 1980. Contract AC01-77ET20160. 155p. NTIS, PC A08/MF A01.

Design and operation of either large or small scale solar and wind energy conversion systems should be based, in part, on knowledge of expected solar and wind power trends. For this purpose, historic solar and wind data available at 101 National Weather Service stations were processed statistically. Preliminary planning data are provided for selected daily average solar and wind power conditions occurring and persisting for time periods of interest. Solar data are global radiation incident on a horizontal surface, and wind data represent wind power normal to the air flow. Empirical probabilities were constructed from the historic data to provide a reasonable inference of the chance of similar climatological conditions occurring at any given time in the future. (Diurnal wind power variations were also considered.) Ratios were also generated at each station to relate the global radiation data to insolation on a south-facing surface inclined at various angles. In addition, joint probability distributions were derived to show the proportion of days with solar and wind power within selected intervals.

38047 (DOE/ET/20274—7) **Coastal zone wind energy. Part I. Synoptic and mesoscale controls and distributions of coastal wind energy.** Garstang, M.; Nnaji, S.; Pielke, R.A.; Gusdorf, J.; Lindsey, C.; Snow, J.W. (Virginia Univ., Charlottesville (USA). Dept. of Environmental Sciences). Mar 1980. Contract AS06-76ET20274. 192p. NTIS, PC A09/MF A01.

This report describes a method of determining coastal wind energy resources. Climatological data and a mesoscale numerical model are used to delineate the available wind energy along the Atlantic and Gulf coasts of the United States. It is found that the spatial distribution of this energy is dependent on the locations of the observing sites in relation to the major synoptic weather features as well as the particular orientation of the coastline with respect to the large-scale wind.

ECONOMICS

REFER ALSO TO CITATION(S) 37814, 38727

38048 (RFP—3128/05480/3533/80-6) **Current state incentive programs for small wind energy conversion systems.** Kornreich, T.R.; Devine, D. (Science Applications, Inc., McLean, VA (USA)). Jul 1980. Contract AC04-76DP03533. 81p. NTIS, PC A05/MF A01.

The objective of this study is to prepare a summary report describing the state incentive programs for small wind energy conversion systems (SWECS) as of December 31, 1979. Written primarily for the use of state governments, this report focuses on the current status of state incentive programs and regulations throughout the United States. To maximize the utility of this document to the states, an up-to-date description of current programs is provided. Based on the examination of all state incentive programs in effect during this reporting period, the programs are divided into six categories: (1) Income Taxes, (2) Property Taxes, (3) Sales and Use Taxes, (4) Loans, (5) Grants, and (6) Other. The effect of the state programs on SWECS usage is also examined.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 38727

WIND ENERGY ENGINEERING

REFER ALSO TO CITATION(S) 37884

APPLICATIONS

38049 (PB—80-129158) **Production of methane using offshore wind energy. Quarterly progress report, 1 Apr-30 Jun 1975.** Young, R.B.; Tiedemann, A.F. Jr.; Marianowski, L.G.; Camara, E.H. (AAI Corp., Baltimore, MD (USA)). Jul 1975. Contract NSF-C-993. 63p. NTIS, PC A04/MF A01.

The feasibility of converting wind energy to methane gas was investigated. The basic approach consists of using off-shore winds to drive generators which supply electricity to electrolysis cells. Electrolysis of distilled sea water produces hydrogen. Carbon dioxide is derived from underwater carbonate deposits. These gases are combined to form methane. In this report period, in-depth thermochemical analyses were made of two candidate processes. Their efficiencies, mass flows, and thermodynamic balances were established. The type and availability of equipment to implement the process on a commercial scale were identified. On the basis of these studies a preferred process has been selected. Hourly wind data covering a period of several years was obtained for a candidate site. The data was analyzed to provide estimates of the amount and variability of energy available to the plant on an hourly basis. Also, a survey of both inland and off-shore calcium carbonate deposits was conducted.

TURBINE DESIGN AND OPERATION

38050 (DOE/NASA/1004—77/10) **Installation and initial operation of a 4100 watt wind turbine.** Tryon, H.B.; Richards, T. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Dec 1975. Contract AI01-76ET20370. 28p. (NASA-TM-X—71831). NTIS, PC A03/MF A01.

Portions of document are illegible.

The objective was to gain some early, practical experience in the wind power field by purchasing and operating a commercial wind turbine. The purpose of this report is to describe that wind turbine activity, its controls, the machine installation, the initial operation, and the results obtained.

38051 (RFP—3007(Vol.1)) **Development of an 8 kilowatt wind turbine generator for residential type applications. Phase I. Design and analysis, executive summary.** Adler, F.M.; Angeloff, L.G.; Henton, P.; King, P.W. (Gruman Energy Systems, Inc., Bohemia, NY (USA)). Mar 1980. Contract AC04-76DP03533. 15p. NTIS, PC A02/MF A01.

This report is an account of the work performed by Grumman Energy Systems in accordance with the Phase I (Design Evaluation) Work Statement of Contract No. PF71787-F, Development of an 8 kW Wind Turbine Generator (WTG), issued on 3 January 1978. This represents an element of an overall program entitled Technical and Management Support for the Development of Wind Systems for Farm and Rural Use, managed by the Wind Systems Program, Rocky Flats Plant, Energy Systems Group of Rockwell International on behalf of the Department of Energy. The goal of this program is to develop Wind Energy Conversion Systems (SWECS) with potential for rapid commercialization, and which will be economically viable in rural and residential areas. The objective of the 8 kW WTG program is to develop and provide a practical prototype capable of being manufactured and sold at prices competitive with alternative energy sources.

38052 (RFP—3007(Vol.2)) **Development of an 8 kilowatt wind turbine generator for residential type applications. Phase I. Design and analysis, technical report.** Adler, F.M.; Angeloff, L.G.; Henton, P.; King, P.W. (Gruman Energy Systems, Inc., Bohemia, NY (USA)). Mar 1980. Contract AC04-76DP03533. 92p. NTIS, PC A05/MF A01.

This report is an account of the work performed by Grumman Energy Systems in accordance with the Phase I (Design Evaluation) Work Statement of Contract No. PF71787-F, Development of an 8 kW Wind Turbine Generator (WTG), issued on 3 January 1978. This represents an element of an overall program entitled Technical and Management Support for the Development of Wind Systems for Farm and Rural Use, managed by the Wind Systems Program, Rocky Flats Plant, Energy Systems Group of Rockwell International on behalf of the Department of Energy. The goal of this program is to develop Wind Energy Conversion Systems (SWECS) with potential for rapid commercialization, ar.d which will be economically viable in rural and residential areas. The objective of the 8 kW WTG program is to develop and provide a practical prototype

capable of being manufactured and sold at prices competitive with alternative energy sources.

38053 (RFP—3121/3533/80/8) **Technical and management support for the development of small wind systems. FY 1980 program summary.** (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1 Mar 1980. Contract AC04-76DP03533. 41p. NTIS, PC A03/MF A01.

This document gives an overview of the Rocky Flats Small Wind Systems Program operated by the Rockwell International Energy Systems Group for the US Department of Energy. This program provides technical and management support for the development of small wind systems. The overall objective is to stimulate the manufacture of small wind energy conversion systems by the private sector and utilization of these systems by the public. The information provided in this document describes the current program in terms of its objectives and role, interprogram relationships, program administration, activity highlights, and plans for FY 1980 as well as projections through 1982.

38054 (RFP—3126/3533/80-2) **Technical and management support for the development of small wind systems. FY 1979 annual report, October 1, 1978-September 28, 1979.** (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). Dec 1979. Contract AC04-76DP03533. 127p. NTIS, PC A07/MF A01.

The FY 1979 Annual Report of the Rocky Flats Wind Systems Program describes the objectives, approach, and achievements of the program and each of its task areas during the period October 1, 1978-September 28, 1979. During this period, additional testing of 17 small wind energy conversion systems (SWECS) was conducted and the Test Centter's capabilities were expanded to include controlled velocity and vibration testing of SWECS. Work on eight design and analysis projects for advanced prototypes in three size ranges progressed through a series of design reviews and fabrication was initiated. Prototype delivery is scheduled to begin in late 1979. Procurement actions for new 15 kW and 4 kW systems were conducted, with two 15 kW contracts awarded in FY 1979 and three 4 kW awards expected in early FY 1980.

38055 (SAND—80-0475) **Torque ripple in a Darrieus, vertical axis wind turbine.** Reuter, R.C. Jr. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1980. Contract AC04-76DP00789. 36p. NTIS, PC A03/MF A01.

Interaction between a steady wind and a rotating, Darrieus, vertical axis wind turbine produces time periodic aerodynamic loads which cause time dependent torque variations, referred to as torque ripple, to occur in the mechanical link between the turbine and the electrical generator. There is concern for the effect of torque ripple upon fatigue life of drive train components and upon power quality. An analytical solution characterizing the phenomenon of torque ripple has been obtained which is based upon a Fourier expansion of the time dependent features of the problem. Numerical results for torque ripple, some experimental data, determination of acceptable levels and methods of controlling it, are presented and discussed.

SITE CHARACTERISTICS

REFER ALSO TO CITATION(S) 38047

38056 (PB—80-125586) **Paleontological potential of five wind energy sites in Albany and Carbon Counties, Wyoming.** McGrew, P.O. (McGrew (Paul O.), Laramie, WY (USA)). 14 Apr 1978. Contract DI-8-01-70-05530. 10p. NTIS, PC A02/MF A01.

Paleontological investigation was carried out at five proposed sites. No paleontological resources were found. No adverse effects will occur.

ELECTRIC POWER ENGINEERING

POWER PLANTS AND POWER GENERATION

REFER ALSO TO CITATION(S) 37874, 39206

38057 (DOE/RA—0052-01) **Systems engineering for power: program report.** (Department of Energy, Washington, DC (USA). Div. of Electric Energy Systems). Aug 1980. 196p. NTIS, PC A09/MF A01.

This is the fifth edition of the Systems Engineering for Power program report. Fifteen projects, classified as either systems control studies or systems deveopment and forecasting, are described and the current status of each project is summarized. The projects include: emergency operating state control; modeling and simulation; normal operating state control; load modeling; multiterminal HVDC systems; generating plant control; operations scheduling; dynamic security assessment; large scale system structuring; storage evaluation; network analysis; system effectiveness analysis; distribution system planning; complex system stability; and industry functional modeling. (LCL)

38058 (EPRI-AP—1470) **Workshop proceedings: the role of personnel error in fossil fuel power plant equipment reliability.** Finnegan, J.P. (Failure Analysis Associates, Palo Alto, CA (USA)). Jul 1980. 74p. NTIS, PC A04/MF A01.

This workshop was convened in response to emerging utility concern as the concluding part of the EPRI sponsored study conducted by Failure Analysis Associates on The Role of Personnel Errors in Power Plant Equipment Reliability. The purposes of the workshop were to (1) review the results of the study, (2) examine the nature of some personnel errors which affect fossil-fuel power plant equipment reliability, (3) establish priorities and goals aimed at error reduction, and (4) initiate technical planning of the necessary long-range efforts. The workshop began with presentations by utility representatives and human factors engineers. After general discussion, the attendees divided into three working groups. Various aspects of the problem were discussed and potential solutions were identified within each group and discussed with the general audience. Transcripts of each formal presentation and summaries of working group recommendations are included.

38059 (EPRI-CS—1529) **Power plant operator curriculum planning guide. Final report.** Hull, D.M.; Rinard, B.F. (Center for Occupational Research and Development, Waco, TX (USA)). Sep 1980. 221p. NTIS, PC A10/MF A01.

The Power Plant Curriculum Planning Guide is one of three such guides developed as part of Project RP 1266-6, Educational Research in Solid-Fuel Technology. The first phase of this project has identified a need for over 31,600 entry-level operators over the next decade. As the power plant reliability depends heavily on the ability of operators to perform their jobs safely and efficiently, a specialized curriculum has been developed. The curriculum was designed for use in employer training programs and has been formulated around detailed task inventories of the skills and knowledge required by operators on the job. The curriculum is divided into three levels, which correspond to the progression of an operator from entry-level to control room operator. Course and module descriptions, outlines, and performance objectives are presented.

COOLING AND HEAT TRANSFER EQUIPMENT AND SYSTEMS

38060 (EPRI-CS—1530) **Advanced concepts test facility: measurements and suggested test plan. Interim report, September 1980.** Zaloudek, F.R.; Brown, L.J.; Allemann, R.T. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Sep 1980. Contract AC06-76RL01830. 114p. NTIS, PC A06/MF A01.

The Advanced Concepts Test (ACT) Facility is being designed to test an advanced concept of dry cooling that uses intermediate ammonia-heat-transport and water augmentation. The instrumentation and test strategies at the design criteria stage that will accomplish the objective of determining the performance and operational feasibility of the advanced cooling tower and some of its components are described. The accuracy of measurement and statistical treatment of the results are discussed extensively. The various types of tests are described and the data acquisition system logging of the data are also covered. The document contains listings of the instrumentation, the data acquisition system connections, and tables of run plan strategies for several types of tests. The general indication is that the specified instrumentation will be sufficiently accurate to evaluate the performance of, and the design formulations for, this type of dry or dry/wet cooling tower.

POWER CYCLES

REFER ALSO TO CITATION(S) 38563

38061 **Utility system planning effects on the economic merit of advanced combined cycle power systems.** Fraize, W.; Davis, F.; Manning, G. *Am. Soc. Mech. Eng.*, [*Pap.*]: No. 80-GT-105, vp(1980).

Many systems studies of advanced power technologies use cost of electricity as an economic figure of merit in comparing electric power generating technologies. For this parameter to be used in comparisons among technologies, it is important to account for the variations in ways that different technologies are integrated into a utility system. These variations result from differing technology-specific characteristics and differing utility characteristics. This paper illustrates the effect of some of these variations on the economic merit of advanced combined cycle power systems relative to a conventional coal-fired steam power plant. 6 refs.

WASTE-FUELED SYSTEMS

38062 Bagasse used as fuel in boilers to generate electricity. Pepeekeo, HI; Hilo Coast Processing Co. ([Ind]). 3p. (NP—25112).

The generation of process heat and electric power at the Hilo Coast Processing Co. (HCPC) using bagasse as the boiler fuel is discussed. The Pepeekeo Sugar factory of HCPC burned 2.7 million tons of bagasse in 1979, and produced 140 x 10^6 kWh of electricity and 2.194 x 10^9 lb of steam. 10.5 x 10^6 kWh of electricity produced were sold to the Hawaiian Electric Co. This represents abut 23% of the annual power demand for the entire Island of Hawaii. (LCL)

38063 (EPRI-AP—1483) **Study of the feasibility of cogeneration using wood waste as fuel. Final report.** Thorn, W.F.; Hoskins, R.L.; Wilson, D. (Rocket Research Co., Redmond, WA (USA)). Aug 1980. 239p. NTIS, PC A11/MF A01.

The objective of this study was to evaluate the feasibility of establishing a wood- and refuse-burning thermal/electrical cogeneration facility in eastern Lewis County, Washington. The work was sponsored by 10 industrial, federal, county, and utility organizations and was carried out in a 6-task, 5-month program. The types, forms, sources, costs, and availability of fuels in the area were studied along with local thermal markets and regional electrical markets. Conceptual designs, including the selection and sizing of the principal pieces of equipment, were developed for both a cogeneration and condensing cycle plant. An assessment was made of the environmental and regulatory requirements applicable to the facilities. The estimated capital and operating costs of each facility were established. Energy costs and standard capital investment economic parameters for various ownership forms were determined. The results of the study clearly indicate the feasibility of establishing a 25-MW(e) generation facility in this area. The primary location recommended is in the town of Morton, Washington. The cost of producing electrical energy is lowest with the public-utility form of ownership and the first year cost is estimated at 29.0 mills/kWh in 1979 dollars. The overall direct construction cost for a condensing cycle generation plant is estimated at $30,865,200 in 1979 dollars. A Phase II program plan was developed which outlines the requirements and schedule for acquisition of the facility. The Phase II detailed design and construction program is recommended.

COMPONENTS

38064 (CONF-8004103—) **Proceedings of the Department of Energy advanced gas turbine central power systems workshop.** D'Angelo, S. (ed.). (Washington Scientific Marketing, Inc., DC (USA)). 1980. Contract AC01-76ET10354. 196p. NTIS, PC A09/MF A01.

From DOE advanced gas turbine central power systems workshop; Washington, DC, USA (30 Apr 1980).

The basic objective of the DOE Central Power Systems group is the development of technology for increasing the use of coal in central station electric power generation in an economical and environmentally acceptable manner. The two major research and development areas of this program are the Open Cycle Gas Turbine System and the Closed Cycle Gas Turbine System. Recognizing that the ultimate success of the DOE program is measured by end-user acceptance of the technology developed, the workshop was held to obtain utility industry comments and suggestions on the development of these systems and their potential use by electric power utilities. Representatives of equipment manufacturers, architect and engineering firms, and universities were also invited as participants to provide a comprehensive review of the technology development and implementation process. The 65 participants and observers examined the following topics: technical considerations of the Open Cycle and of the Closed Cycle Gas Turbine program; commercialization of both systems; and regulatory impacts on the development of both systems. Each group evaluated the existing program, indicating R and D objectives that they supported and cited recommendations for modifications and expansion of future R and D work.

38065 (DOE/ET/15425—T1) **Compressor configuration and design optimization for the high reliability gas turbine. Final report.** Day, D.L. (United Technologies Corp., South Windsor, CT (USA). Power Systems Div.). Apr 1980. Contract AC03-79ET15425. 54p. (GTR—2136). NTIS, PC A04/MF A01.

The purpose of this program has been to develop a preliminary design of a low aspect ratio/high through-flow compressor configuration to be compatible with the Electric Power Research Institute/Department of Energy/Reliable Advanced Liquid Fueled Engine (EPRI-DOE/RALFE) program and to evaluate the design for use in the Reliable Engine. Our objective was to define the benefits of low aspect ratio and high through-flow (HTF) in a large industrial gas turbine in which high reliability and cost-of-electricity (COE) are major design considerations. These benefits have been identified, in aircraft gas turbines, as reduced number of stages, with reduced number of parts, and increased aerodynamic loading capability. The compressor and diffuser preliminary designs have been completed to define size and performance characteristics. The compressor has 9 stages and a predicted adiabatic efficiency of 88.35%. The diffuser selected is a conventional straightwall configuration with an equivalent conical angle of 8-degrees. An alternate diffuser configuration has also been recommended because of its excellent performance potential in high Mach number applications. The HTF compressor configuration appears to offer equivalent COE and reliability as compared to the Baseline Reliable Engine configuration, but at more conservative aerodynamic loading levels.

38066 (EPRI-AP—1539(Pt.1)) **Ceramic turbine components research and development. Part 1. Ceramic rotor-blade development. Final report.** Anderson, C.A.; Boorer, C.R. Jr. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center; Westinghouse Electric Corp., Concordville, PA (USA). Combustion Turbine Systems Div.). Aug 1980. 277p. NTIS, PC A13/MF A01.

The principal objective of this program was to develop (through design, analysis and laboratory spin testing) the design techniques for uncooled ceramic rotor blades. Present-day materials, fabrication techniques and system operating conditions were assumed in the program. The unique compound curvature dovetail attachment concept was generated and two configurations of this concept were generated for detailed study. In addition a three-piece blade assembly consisting of ceramic blade/superalloy intermediate piece/metal disk was conceived. An additional important design feature was the use of a compliant layer pad between ceramic and metal contact surfaces. Silicon nitride root forms of two preliminary root designs with flat surface dovetails and of the two configurations with compound curvature dovetails were manufactured and spin tested to failure with very encouraging results. A statistical assessment of failures was conducted by combining results from finite element stress analysis and the statistical mechanical properties of Norton NC 132 silicon nitride. This provided a failure prediction method that correlated well with the spin test results. The significant influence of surface finish that translates to surface flaw severity and orientation was dramatically illustrated in this study and points to the need for improved methods of manufacturing ceramic components for gas turbine application.

38067 (EPRI-AP—1539(Pt.2)) **Ceramic turbine components research and development. Part 2. evaluation of MCrAlY/ZrO_2 (Y_2O_3) thermal-barrier coatings exposed to simulated gas turbine environments. Final report.** Singhal, S.C.; Yee, S.Y. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). Aug 1980. 79p. NTIS, PC A05/MF A01.

The purpose of this study was to determine the resistance of two state-of-the-art duplex thermal barrier coating systems to utility turbine combustion gases. These coating systems are of interest because large electricity cost savings could be achieved if the coatings permit turbine operation with residual fuels at distillate-rated firing temperatures, and substantial savings in fuel and capital cost may be achieved through increased turbine inlet temperature. The coating systems evaluated consisted of a MCrAlY (M = Ni or Ni/Co) bond coat and ZrO_2 stabilized with 12 wt% Y_2O_3 overcoat, each deposited by plasma arc spray on Udimet-500 turbine alloy specimens. The corrosion testing was conducted in a pressurized turbine test passage at 2000°F gas temperature using GT-2 diesel oil and that containing Na, V, P and S contaminants. Post-test analysis showed that the coatings performed well when exposed to clean GT-2 fuel and that containing 1 ppM Na or 5 ppM Pb; but in the presence of vanadium and/or phosphorous in the fuel, the ZrO_2 - 12 wt % Y_2O_3 coating deteriorated through severe cracking and eventual spalling. Various possible causes for the oxide coating degradation are discussed. This work shows that the thermal barrier coating concept is feasible for utility turbines, but coating development specifically for utility turbines burning residual fuels will be required.

38068 (EPRI-AP—1539(Pt.3)) **Ceramic turbine components research and development. Part 3. ceramic combustor design and analysis. Final report.** Lew, H.G.; DeCorso, S.M.; Dickson, W.H.; Hung, W.S.Y.; Glenn, R.G.; Tobery, E.W.; Olson, B.A.; Osgerby, I.T. (Westinghouse Electric Corp., Concordville, PA (USA). Combustion Turbine Systems Div.). Aug 1980. 150p. NTIS, PC A07/MF A01.

An analytical and design program relating to a catalytic ceramic low emission combustor element for industrial combustion turbine application has been performed. Preliminary analysis including a survey of literature has helped identify certain design considerations. Subsequently, preliminary designs of the total combustion system and conceptual designs of the catalytic ceramic element are proposed. A thermo-mechanical analysis of the major components in these conceptual designs has been performed for both steady-state and transient (shut-down) situations. Consequently, an arrangement to build a viable catalytic ceramic combustor element has been identified which is expected to perform its mechanical functions. In addition, a conceptual design of the support structure of a catalyst element in the combustion system using transpiration cooling has

been made. A thermo-mechanical analysis of this porous structure has been performed for steady state conditions and results show improvements in stress and the amount of cooling air required compared to film cooling. Experimental results on the behavior of catalytically supported combustion under typical turbine operating conditions are presented. They were obtained in two flow passages containing Engelhard catalysts of one inch and nine inch diameters and burning No. 2 diesel fuel. A series of axial catalyst monolith temperature profile measurements were made for two lengths of catalyst usin small diameter, high temperature, sliding thermocouples positioned in sealed monolith channels. Process variable effects of air preheat temperature, adiabatic flame temperature (based on fuel/air ratios), catalyst inlet reference velocity, and catalyst length were determined.

38069 (EPRI-AP—1539-SY) **Ceramic turbine components research and development.** (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). Aug 1980. 34p. NTIS, PC A03/MF A01.

The three separate but interrelated subjects that are concerned with the application of ceramics to advanced combustion turbine systems are discussed; namely, Part I - Ceramic Rotor Blade Development, Part II - Evaluation of MCrAlY/$ZrO_2(Y_2O_3)$ Thermal Barrier Coatings, and Part III - Catalytic Combustor Development. In each of these areas of development, emphasis was placed on the design, analysis and testing of both the ceramic component and its metal support structure.

38070 (EPRI-CS—1444(Vol.3)) **Air/gas system dynamics of fossil fuel power plants. Volume 3. Experimental pressure test data of a 500-MW unit and of a 125-MW unit. Final report.** Goldschmied, F.R.; Wormley, D.N.; Rowell, D.; Brown, J.E. Jr. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Labs.; Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Mechanical Engineering; NUS Corp., Clearwater, FL (USA)). Sep 1980. 92p. NTIS, PC A05/MF A01.

This study addresses combustion air/flue gas system dynamic problems in fossil fuel power plants. These problems are characterized in terms of significant pressure and flow dynamic variations. These dynamic pressure variations have led to equipment and ductwork vibrations in a number of plants which have eventually resulted in ductwork and/or equipment failure. Methods have been developed for instrumenting plants and analyzing data to identify sources of air/gas system dynamic problems. These techniques were applied to two oil-fired, balanced-draft plants to obtain data for cold and hot operation. The data analysis identified low-frequency periodic oscillations in both plants that resulted from air preheater rotation. Also pressure spectra were measured for forced-draft, induced-draft, and recirculation fans and the associated ductworks. The data analysis indicated that forced-draft fans in both plants had relatively low variations in pressure amplitude, and induced-draft fans had significant levels of pressure variation. The recirculation fans in both plants had high levels of pressure variation, which excited recirculation duct-acoustic modes. The analysis of data for one plant indicated the existence of conditions in the recirculation loop at low-load levels in which a component of fan rotating stall noise matched in frequency and was amplified by a duct-acoustic natural mode of vibration. This pressure vibration excited fan and duct structures to noticeable levels of vibration.

38071 (FE—1806-72) **Development of high-temperature turbine subsystem technology to a technology readiness status, Phase II. Quarterly report, July-September 1979.** (General Electric Co., Schenectady, NY (USA). Gas Turbine Div.). Oct 1979. Contract EX-76-C-01-1806. 172p. NTIS, PC A08/MF A01.

The objective of the DOE-HTTT (High-Temperature Turbine Technology) program is to bring to technology readiness, over a six- to ten-year duration, a high-temperature turbine for use in a combined cycle, using coal-derived fuel at a firing temperature of 2600°F with growth capability to 3000°F. The program has been divided into three phases: Program and System Definition, Technology Testing and Test Support Studies, and Technology Readiness Verification Test Program. The work scope for the overall three phases of the DOE-HTTT program encompasses the design, development, manufacture, and test of a GE-TRV turbine subsystem to be tested at a DOE facility. Phase I was completed and Phase II commenced on August 1, 1977. The objectives of Phase II are to: (1) perform component design and technology testing in critical areas; (2) perform system design and trade-off analyses in sufficient depth to support the component design and test tasks; and (3) update the Phase I combined cycle studies to evaluate the commercial viability of GE-TRV turbine system.

38072 **Effect of pressure and turbine inlet temperature on the efficiency of pressurized fluidized bed power plants.** Graves, R.L. (Oak Ridge Natl Lab, Tenn). *Am. Soc. Mech. Eng., [Pap.]*; No. 80-GT-102, vp(1980).

The difficulties encountered in past and present efforts to operate direct coal-fired gas turbines are substantial. Hence the development effort required to assure a reliable, high-temperature pressurized fluidized bed (PFBC) combined cycle may be very expensive and time consuming. It is, therefore, important that the benefit of achieving high-temperature operation, which is primarily increased efficiency, be clearly understood at the outset of such a development program. This study characterizes the effects of PFBC temperature and pressure on plant efficiency over a wide range of values. 16 refs.

WASTE HEAT UTILIZATION

REFER ALSO TO CITATION(S) 38063

38073 (ORNL/TM—6830/P12) **District heating/cogeneration application studies for the Minneapolis-St. Paul area: allocation methods for the separation of electrical and thermal cogeneration costs.** Pavlenco, G.F.; Englesson, G.A. (Oak Ridge National Lab., TN (USA)). Oct 1980. Contract W-7405-ENG-26. 88p. NTIS, PC A05/MF A01.

Allocation methods proposed in the US and Europe for separating electricity and heat cogeneration costs were evaluated for their suitability for dual-purpose plants equipped with either new cogeneration turbines or turbines retrofitted for cogeneration. Both direct and indirect allocation methods were considered. The distinction between the two groups of methods depends upon whether the cost allocation is made by separating the total annual costs (directly), or by separating individually the various fixed and variable costs (indirectly). All methods considered were applied to the case of a large cogeneration/district heating plant equipped with a new 800-MW(e) condensing-tail turbine assumed to be operating in the Minneapolis-St. Paul area. The unit costs obtained for electricity and heat were compared with those determined for separate generation of the two forms of energy. Costs for the High Bridge Station Retrofit Study were allocated using only two direct allocation methods (Margen and equal discount) because the absence of detailed capital cost information for various plant equipment did not permit the application of any indirect allocation method. Of the methods considered, the equal discount method appeared to be a good choice for new cogeneration units. With this method, both the heat and electricity users would share the economic benefits of cogeneration. For plants retrofitted to cogeneration, such as the High Bridge Station, the Margen method was recommended because it provides incentives to heat users to convert from existing systems to district heating systems while not penalizing existing electric customers.

38074 **Gas turbine plant with a heat exchanger for using waste heat behind the gas turbine.** Brueckner, H.; Brandl, A. (to Kraftwerk Union A.G., Muelheim an der Ruhr (Germany, F.R.); Deutsches Patentamt, Muenchen (Germany, F.R.)). German(FRG) Patent 2,733,931/B/. 23 Aug 1979. 6p. (In German).

The waste gas pipe ends in a bend, which deflects the flow of gas vertically upwards. It contains the heat exchanger with pipes and a free part in the center. The part with pipes or the free part can be closed by means of individual flaps. The plant is suitable for peak load running.

ECONOMICS

38075 (EPA—600/7-79-167a, pp 89-136) **Status of development, energy and economic aspects of alternative technologies.** Farber, P.S.; Livengood, C.D.; Wilzbach, K.E.; Buck, W.L.; Huang, H. (Argonne National Lab., IL). Jul 1979.

From 5. flue gas desulfurization symposium; Las Vegas, NV, USA (5 Mar 1979).

A summary of the operating and economic characteristics of the alternative processes is shown in Table 23. The overall heat rates of the pressurized-fluid-bed; IGT gasifier, Foster-Wheeler gasifier, and Texaco gasifier power plants are approximately equivalent and are lower than that of comparable conventional coal-burning power plants with flue-gas desulfurization (about 9900 Btu/kWh). Examination of the total power cost, in mills/kWh, of the alternative processes leads to several conclusions, including: (1) at the current stage of development, solvent-refined coal is not a viable option for replacement of conventional coal power generation with flue-gas desulfurization; (2) of the gasification/combined-cycle systems studied, the IGT U-Gas and Foster-Wheeler processes offer the best possiblities for replacement of conventional coal-buring power plants (Whether or not the Texaco gasification process will be able to compete successfully with these will depend upon further cost refinements and reduction in overall capital requirements.); and (3) pressurized fluidized-bed combustion is a viable option for electric-power generation and may become even more so if sorbent-regeneration processes are successfully developed. A change in the cost of coal is shown to have little or no effect on the economic rankings, although some of the processes show a greater dependence on fuel cost than do others. All of the processes are in the pilot-plant or demonstration stage so

great caution should be taken in using the costs given in this paper as absolute rather than relative numbers.

FUELS

38076 (DOE/ET/11313—T1) **Fundamental characterization of alternate fuel effects in continuous combustion systems. Summary technical progress report, August 15, 1978-January 31, 1980.** Blazowski, W.S.; Edelman, R.B.; Wong, E. (Exxon Research and Engineering Co., Linden, NJ (USA). Corporate Research-Technology Feasibility Center; Science Applications, Inc., Canoga Park, CA (USA)). 27 Feb 1980. Contract AC03-77ET11313. 123p. NTIS, PC A06/MF A01.

The overall objective of this contract is to assist in the development of fuel-flexible combustion systems for gas turbines as well as Rankine and Stirling cycle engines. The primary emphasis of the program is on liquid hydrocarbons produced from non-petroleum resources. Fuel-flexible combustion systems will provide for more rapid transition of these alternative fuels into important future energy utilization centers (especially utility power generation with the combined cycle gas turbine). The specific technical objectives of the program are: (a) develop an improved understanding of relationships between alternative fuel properties and continuous combustion system effects, and (b) provide analytical modeling/correlation capabilities to be used as design aids for development of fuel-tolerant combustion systems. This is the second major report of the program. Key experimental findings during this reporting period concern stirred combustor soot production during operation at controlled temperature conditions, soot production as a function of combustor residence time, an improved measurement technique for total hydrocarbons and initial stirred combustor results of fuel nitrogen conversion. While the results to be presented concern a stirred combustor which utilizes premixed fuel vapor/oxidant mixtures, a new combustor which combusts liquid fuel injected into the reactor as a spray has been developed and will be described. Analytical program progress includes the development of new quasiglobal models of soot formation and assessment of needs for other submodel development.

38077 (FE—2468-79) **ESCOE engineering program. Quarterly report, March 1-May 31, 1980.** Hill, R.F. (Engineering Societies Commission on Energy, Inc., Washington, DC (USA)). 20 Jun 1980. Contract AC01-77ET10679. 16p. NTIS, PC A02/MF A01.

In this task a systematic technique was developed for assessing the opportunities, constraints, costs and impacts associated with the conversion of oil- and gas-fired electric power plants to coal or coal-derived fuels. The final task report, Regional Conversion to Coal, Fe-2468-63 has been issued. The report describes an investigation of powerplant conversion from oil to coal, and the options and technical problems confronting electric utility companies in an example region (New England), but the analysis format is valid for other regions having different specific conditions but facing the same general conversion mandates. The report discusses the ramifications of various types of coal conversion, particularly in the area of steam generator design characteristics, the importance of coal prperties on steam generator and auxiliaries design, plant layout considerations, the transportation situation, approximate costs of conversion, environmental issues, and approximate costs of emissions control equipment. Although some New England powerplants were originally designed to burn coal, most newer fossil-fired plants in New England were designed only for oil. Because of its physical characteristics, simple conversion to coal of a utility steam boiler unit designed for oil is not feasible. Boiler replacement or pre-boiler coal liquefaction or gasification would be required to make the conversion to coal. The report does note, however, that coal-oil mixture combustion is a promising concept for the partial displacement of oil that could have significant application in New England. Other tasks are discussed briefly.

38078 **Interrelationship between soot and fuel NO/sub x/ control in gas turbine combustors.** Blazowski, W.S.; Sarofim, A.F.; Keck, J.C. (Exxon Res and Eng Co, Linden, NJ). *Am. Soc. Mech. Eng., [Pap.]*; No. 80-GT-76, vp(1980).

With increased emphasis on the utilization of US energy resources for national self-reliance, alternative (synthetic) fuels are expected to play a major role in future energy developments. Future electric power generation with combined cycle gas turbines can make a major contribution to national energy goals if these systems could be made to accept synthetic liquid fuels having minimum upgrading. Development of such fuel-flexible gas turbines will encourage the utilization of synthetic fuels as they enter the marketplace, have major impact on future conversation of petroleum supplies, and reduce the cost of power production. This paper reviews the evidence for the importance of hydrocarbon breakthrough, explains our current understanding of why hydrocarbon breakthrough is important, and offers suggestions of how these results might be applied. 28 refs.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 38653

THERMAL EFFLUENTS

REFER ALSO TO CITATION(S) 38726

38079 **Thermal discharge field studies.** Crum, M. (Aluminum Company of America, Pittsburgh, PA). pp 639-642 of Proceedings of the 32nd industrial waste conference. Ann Arbor, MI; Ann Arbor Science Publishers, Inc. (1978).

From 32. industrial waste conference; Lafayette, IN, USA (10 May 1977).

In June and August of 1975, data were collected in the field to determine the characteristics of thermal discharges from two power plants located along the Ohio River. The data obtained were utilized as part of a successful effort to obtain variances from the steam-electric power generating effluent guidelines as allowed by section 316(a) of the Federal Water Pollution Control Act. Section 316(a) allows less stringent effluent limitations to be imposed on the thermal component of a discharge, provided that the owner or operator of the source can demonstrate that the effluent limitations are more stringent than necessary to protect aquatic life. Field studies documenting the extent of thermal plume are a necessary part of the demonstration. This study is of interest since it was one of the few thermal discharge studies on the Ohio River in which an outside consultant was not utilized. The study consisted of characterizations of thermal plume configurations under two different flow regimes and a literature search of thermal tolerances of fish species commonly occurring in the Ohio River. The techniques used for this study could be utilized by other power companies to perform 316(a) demonstrations at low cost. The data obtained give accurate indications of maximum temperatures in the plume, plume size and dispersion rates. Such data also can be used to validate the thermal components of a water quality model.

NOXIOUS GAS AND PARTICULATE ABATEMENT AND CONTROL

REFER ALSO TO CITATION(S) 37513, 37514, 37515, 37516, 37517, 37518, 37519, 37520, 37521, 37522, 37523, 37524, 37525, 37526, 37527, 37528, 37529, 37530, 37531, 37532, 37533, 37534, 37535, 37536, 37542, 37543, 37544, 38233, 38299, 38567, 38709, 38878

38080 (BNL—28352) **Conversion rates in power plant plumes based on filter pack data. Part I. Coal-fired Cumberland plume.** Forrest, J.; Garber, R.W.; Newman, L. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 35p. (CONF-801114—5). NTIS, PC A03/MF A01.

From Symposium on plumes and visibility; Grand Canyon, AZ, USA (10 Nov 1980).

The TVA Cumberland Steam Plant plume was monitored during the August 1978 Tennessee Plume Study of Project STATE. Samples were obtained by employing a triple screen high-volume assembly which contained: (1) a quartz filter for collecting particulate SO_4^{2-}, NO_3^- and NH_4^+, (2) two NaCl-impregnated cellulose filters for collecting gaseous nitrate, and (3) two K_2CO_3-impregnated cellulose filters for collecting SO_2. Formation rates of sulfate and nitrate in the atmosphere were calculated by using total sulfur as a conservative tracer. Conversion of SO_2 to SO_4^{2-} varied from $\sim$ 0.1 to 0.8% h^{-1} during night and early morning hours; late morning and afternoon rates ranged from $\sim$ 1 to 4% h^{-1}. Rate of formation of NO_3^- from NO was $\sim$ 0.1 to 3% h^{-1} and $\sim$ 3 to 12% h^{-1} for similar time periods. Particulate NH_4^+ concentrations generally increased with plume age, but rates of formation varied widely. Mole ratios of NH_4^+/SO_4^{2-} fell within 1 to 3.

38081 (DOE/RA/08726—T1) **Effects of a flexible definition of new source performance standards for utility boilers firing anthracite coal.** Buckley, B.; DeFieux, R.; Holzheimer, R.; Lowenthal, S.; Murphy, B.; Watson, J. (Environmental Research and Technology, Inc., Concord, MA (USA)). Sep 1978. Contract AC01-77RA08726. 102p. NTIS, PC A06/MF A01.

The primary constraints and incentives affecting the viability of increased anthracite production for use as a utility boiler fuel are related to: (1) inherent advantages and disadvantages of anthracite versus bituminous coal, (2) geographical considerations, and (3) the existing and future state and federal regulatory framework. Anthracite is inherently low in sulfur content (a nominal 0.7% versus 2.0% for bituminous coal) and thus is capable of providing energy in a more environmentally beneficial manner than alternative coal resources. In addition, anthracite is characterized by a higher energy output (5% higher per pound) than bituminous coal. On the other hand, anthracite is difficult to mine because of its hardness and the geological environment where it occurs, and thus incurs an initial cost disadvantage relative to alternative fuels. Anthracite has a

higher ignition and burning temperature than bituminous coal and thus requires more costly boilers. Additionally, anthracite requires more costly particulate-removal systems than does bituminous and is somewhat more costly to tranport by rail. A potential major negative factor is the variability of sulfur content within anthracite deposits. The geographic location of the anthracite region creates a number of economic and environmental advantages that influence the viability of increased anthracite production. Anthracite fields in Pennsylvania are within 150 miles of approximately one eighth of the US population, making anthracite more favorable for mine-month power generation than bituminous coal. The anthracite region is currently economically drpressed and unsuitable for most nonmining uses. Thus, anthracite production carries with it a potential for local beneficial environmental and socioeconomic benefits.

38082 (EPA—600/7-79-167a, pp 561-594) **Current alternatives for flue gas desulfurization (FGD) waste disposal: an assessment.** Santhanam, C.J.; Lunt, R.R.; Cooper, C.B. (Author D. Little, Inc, Cambridge, MA). Jul 1979.

From 5. flue gas desulfurization symposium; Las Vegas, NV, USA (5 Mar 1979).

With increasing coal utilization in industrial and utility boilers, generation of coal ash (fly ash and bottom ash), and flue gas desulfurization (FGD) wastes, which together comprise flue gas cleaning (FGC) wastes, is expected to increase dramatically over the next twenty (20) years. Since most of the FGC wastes generated will be disposed of, rather than utilized, these wastes represent significant potential sources of environmental pollution unless proper disposal technology is employed. Continuing research and development efforts sponsored by EPA, EPRI, and others in recent years have provided substantial information on environmentally sound disposal techniques. This paper discusses the current state-of-the-art of flue gas desulfurization (FGD) waste disposal with focus on wastes from nonrecovery systems. The paper includes a review of the following areas: production and categorization of FGC wastes; disposal options presently in use and/or with future potential; and environmental issues associated with various disposal options.

38083 (EPA—600/7-79-167a, pp 595-612) **Marketing alternatives for FGD byproducts: an update.** O'Brien, W.E.; Anders, W.L. (Tennessee Valley Authority, Muscle Shoals, AL). Jul 1979.

From 5. flue gas desulfurization symposium; Las Vegas, NV, USA (5 Mar 1979).

The latest FGD byproduct marketing programs conducted by TVA for EPA are First Annual Update: Potential Abatement Production and Marketing of Byproduct Sulfur and Sulfuric Acid in the US and Flue Gas Desulfurization Byproduct Production and Marketing System Users Manual. The first is an annual update to 1983 of an extensive computer system to project FGD byproduct sulfur and sulfuric acid market potential. Results of this update are presented. Boilers projected to come on-line between 1978 and the end of 1983 are important candidates for marketing FGD byproduct sulfuric acid. A small reduction in total FGD byproduct sulfur costs could result in emergence of some competitive FGD sulfur production. The users manual describes programing, procedures, and techniques required to utilize the computer production and marketing system. The users manual makes the byproduct production and marketing computer system available on a commercial basis through TVA under a technology transfer agreement with EPA. Procedures for access are described.

38084 (EPA—600/7-79-167b, pp 654-701) **Utility conventional combustion comparative environmental assessment: coal and oil.** Leavitt, C.A. (TRW, Inc., Redondo Beach, CA); Shih, C.; Orsini, R.; Arledge, K.; Saur, A.; Peters, W.D. Jul 1979.

From 5. flue gas desulfurization symposium; Las Vegas, NV, USA (5 Mar 1979).

This paper summarizes the results of a comparative multimedia assessment of two utility boilers, one firing coal, the other oil, to determine relative environmental impacts. Comprehensive sampling and analyses of multimedia emissions from the boilers and control equipment were conducted to identify criteria pollutants and other species. The results indicate that: (1) particle emissions from coal firing are 10 times those from oil firing (scrubbing reduced the mean size of the particles from coal firing and increased the emissions of particles below 3 μm size); (2) SO_2 emissions from coal firing are 7 times those from oil firing; (3) NO/sub x/ emissions from coal firing are 6 times those from oil firing; (4) for coal firing, arsenic, cadmium, chromium, iron, nickel, lead, and zinc emissions are of potential environmental concern - for oil firing, only chromium and nickel are of potential concern; (5) organic and polycyclic organic emissions from either fuel are not of environment concern; (6) liquid emissions from coal firing contain many inorganic elements that are of environmental concern although the organic content is innocuous; and (7) solid emissions from coal firing also contain many trace elements at concentrations of concern - there are no significant solid wastes from oil firing.

38085 (EPA—600/7-79-167b, pp 792-808) **Design and commercial operation of lime/limestone FGD sludge stabilization systems.** Bacskai, R.J.; Cleveland, L.C. (IU conversion Systems, Inc., Horsham, PA). Jul 1979.

From 5. flue gas desulfurization symposium; Las Vegas, NV, USA (5 Mar 1979).

The Resource Conservation and Recovery Act will soon mandate standards for SO_2 scrubber sludge and ash waste disposal. It is expected that the FGD wastes will have to be chemically stabilized to minimize environmental degradation and to produce a structural product to minimize land use. This paper discusses the only four commercially operating plants on eastern high sulfur coal. The stabilization process is the IU Conversion Systems Poz-O-Tec System which involves dewatering of the scrubber sludge followed by mixing with waste coal ash and chemical additives to produce a structurally stable and environmentally compatible material for landfill, land reclamation, roadbase, liners and other useful applications. A discussion is provided on the process and plant design considerations which must be evaluated to ensure successful plant operations. Problems encountered in designing and initially operating SO_2 Waste Treatment Systems will be reviewed. The design and operation of these systems involves expertise in material handling, chemical processing, geothermal engineering and regulatory requirements. Emphasis is placed on: (1) plant design problems and solutions for them; (2) variances in SO_2 scrubber sludge and coal ash characteristics and their affect on equipment design, plant operation and chemical stabilization; (3) the handling of the waste materials including the dewatering characteristics of sludges and the controlled feeding of fly ash at higher rates than used previously in any industry; and (4) flexibility of choosing disposal sites with the use of the stabilized material produced in a dry system.

38086 (EPA—600/7-79-167b, pp 1023-1066) **Environmental assessment of the dual alkali FGD system applied to an industrial boiler firing coal and oil.** Fischer, W.H. (Gilbert Associates, Reading, PA); Ponder, W.H.; Zaharchuk, R. Jul 1979.

From 5. flue gas desulfurization symposium; Las Vegas, NV, USA (5 Mar 1979).

This paper summarizes the results of a comparative multimedia assessment of a dual alkali flue gas desulfurization system on a coal/oil industrial boiler to determine relative environmental, energy, economic, and societal impacts. Comprehensive sampling and analyses of multimedia emissions from the boiler and its control equipment were conducted to identify criteria pollutants and other species. The results indicate that: (1) while the quantity of uncontrolled particulate matter from oil-firing is considerably less than from coal-firing, the oil-fired particles are generally smaller and the concentration of particles in the treated flue gas from oil-firing is approximately the same as from coal-firing; (2) uncontrolled emissions of NO/sub x/ and CO during coal-firing are about triple those during oil-firing; (3) while sulfate emissions from the boiler during coal-firing are about triple those during oil-firing, sulfate emissions after the control equipment are essentially identical; (4) emissions of cadmium, calcium, magnesium, nickel and vanadium are higher during oil firing; and (5) oil-firing may produce cadmium concentrations in vegetation approaching levels injurious to humans; coal-firing may produce molybdenum levels injurious to cattle.

38087 (EPRI-CS—1515) **FGD sludge disposal manual. Final report.** Knight, R.G.; Rothfuss, E.H.; Yard, K.D. (Baker (Michael), Jr., Inc., Beaver, PA (USA)). Sep 1980. 716p. NTIS, PC A99/MF A01.

This manual is an update of the one published in January 1979. It incorporates the effects of the New Source Performance Standards (NSPS) of June 1979, and those of the Resource Conservation and Recovery Act (RCRA) to the extent that details are known as of May 19, 1980. Suggestions and guidance are provided to electric utility operators of lime, limestone, alkaline flyash, and double-alkali wet scrubbers in the processing and disposal of the waste product. A decision path diagram illustrates the options available to the operators, and explains the steps necessary to select a disposal system. Current practices in the US and other countries are briefly covered to illustrate trends and to supply possible sources of information for the utility industry. Major and trace components of the sludge are discussed along with their effects on processing and disposal. Methods are presented for estimating the quantity of waste which will be produced under a set of assumed conditions. Both wet (ponding) and dry (landfill) disposal alternatives are described and illustrated, along with site selection and design recommendations for both types. The problem of leachate from such areas is considered and means of prevention or control are evaluated. Options available for processing and disposal and the question of fixation/stabilization are considered in view of the existing regulations and the possible requirements of RCRA. The important subject of processing/disposal cost and the prospects for utilization are considered.

38088 (PB—80-122633) **Epa utility fgd survey: February-March 1979.** Smith, M.; Melia, M.; Koger, T. (PEDCO-Environmental,

Inc., Cincinnati, OH (USA)). Jul 1979. Contract EPA-68-02-2603. 188p. NTIS, PC A09/MF A01.

The report is the second in a series of four generated by a new computerized data base system. The report differs from the previous series in that the scope of design data for operating FGD systems is vastly expanded, section formats are revised, and a new section includes operating particulate scrubbers. The report surveys utility FGD systems in the U.S. It summarizes information contributed by the utility industry, process suppliers, regulatory agencies, and consulting engineering firms. Systems are tabulated alphabetically by development status (operating, under construction, or in planning stages), utility company, process supplier, process, waste disposal practice, and regulatory class. It presents data on system design, fuel sulfur content, operating history, and actual performance. It includes unit by unit dependability parameters and discusses problems and solutions associated with the boilers and FGD systems. Process flow diagrams and FGD system economic data are appended.

38089 (PB—80-124332) **Chemical analysis of wet scrubbers utilizing ion chromatography. Final report sep 77-sep 78.** Acciani, T.R.; Maddalone, R.F. (TRW Defense and Space Systems Group, Redondo Beach, CA (USA)). Jul 1979. Contract EPA-68-02-2165. 63p. NTIS, PC A04/MF A01.

The report describes the key elements required to develop a sampling and analysis program for a wet scrubber using ion chromatography as the main analytical technique. The first part of the report describes a sampling program for two different types of wet scrubbers: the venturi/spray-tower (limestone) scrubber which is part of the EPA/TVA Shawnee Test Facility, Paducah, Kentucky; and the Arthur D. Little dual alkali pilot scrubber. The sampling section of the report describes the scrubber type, sample collection, and sample preservation. The analysis section of the report, describing the theory and practice of ion chromatography as applied to wet scrubber samples, describes analytical procedures, qualitative analysis, and quantitative analysis. The analytical procedures portion covers the anion and cation analysis scheme for wet scrubber samples, the theory of ion chromatography, and current problems involving the use of ion chromatography for wet scrubber related samples.

38090 (PB—80-124829) **Epa/ierl-rtp pilot electrostatic precipitator - selected experiments, 1978. Final report Jun 78-Jun 79.** VanOsdell, D.W.; Sparks, L.E.; Ramsey, G.H.; Daniel, B.E. (Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab.). Nov 1979. 64p. NTIS, PC A04/MF A01.

The report describes experiments with a pilot-scale electrostatic precipitator (ESP) at EPA/IERL-RTP. The ESP is a dedicated experimental tool, operated for experiments originated and designed both in-house and by EPA contractors. Five distinct test series, between March and October 1978, are described: precharger operation, ESP operating characteristics, reentrainment, parameter variation with position within ESP, and effects of humidity. The precharger test results were inconclusive; removal efficiency was 10-20% better with the precharger for most size ranges, but its operation was erratic. In the reentrainment test, sparking produced more and larger particulate than other reentrainment mechanisms. No size distribution change pattern was established. The study of flow, mass, and particle size as a function of sample probe position showed that parameter variations do exist; however, insufficient data was collected to fully establish the differences. In the study of the effects of humidity on collection efficiency, increased moisture had a strong impact on improved performance. Moisture lowered the particulate resistivity, allowing increased electrical fields. Efficiency correlated well with voltage in the form: P=6.59 x 10 to the 8th power x V to the -5.46 power where P=penetration, %, and V=voltage, kV. The correlation coefficient, r2, was 0.97.

38091 (PB—80-124969) **Overview of pollution from combustion of fossil fuels in boilers of the United States. Final report Jan-Jun 79.** Spaite, P.W.; Devitt, T.W. (PEDCO-Environmental, Inc., Cincinnati, OH (USA)). Oct 1979. Contract EPA-68-02-2603. 69p. NTIS, PC A04/MF A01.

The report describes the fossil-fuel-fired boiler population of the U.S. It presents data on the number and capacity of boilers for categories most relevant to producing pollution. Information presented includes: type of fuel burned (coal, residual oil, distillate oil, natural gas); usage sector (utility, industrial, commercial); size category (less than 25 million Btu/hr, 25-250 million Btu/hr, greater than 250 million Btu/hr); and heat transfer configuration (water tube, fire tube, cast iron). Fuel consumption data are presented for each type of fuel burned in each usage sector. These data are used to estimate the amount of sulfur oxide, nitrogen oxide, and particulate air emissions produced by boiler operation. Other air pollutants are discussed qualitatively. Solid waste and water pollution from boiler operation is discussed generally.

38092 (PB—80-125107) **The bioenvironmental impact of a coal-fired power plant, fourth interim report, Colstrip, Montana, December, 1978. Interim report Dec 75-Dec 77.** Preston, E.M.; Gullett, T.L. (Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab.). Apr 1979. 955p. NTIS, PC A99/MF A01.

The EPA has recognized the need for a rational approach to the incorporation of ecological impact information into power facility siting decisions in the Northern Great Plains. Research funded by the Colstrip, Coal-fired Power Plant Project is a first attempt to generate methods to predict the bioenvironmental effects of air pollution before damage is sustained. Pre-construction documentation of the environmental characteristics of the grassland ecosystem in the vicinity of Colstrip, Montana began in the summer of 1974. Since then, key characteristics of the ecosystem have been monitored regularly to detect possible pollution impacts upon plant and animal community structure. In the summer of 1975, field stressing experiments were begun to provide the data necessary to develop dose-response models for SO_2 stress on a grassland ecosystem. These experiments involve continuous stressing of one acre grassland plots with measured doses of SO_2 during the growing season (usually April through October). Results of the 1976 and 1977 field seasons' investigations are summarized in this publication. The six-year project will terminate in 1980 and a final report will be published after data analyses are complete.

38093 (PB—80-125628) **Survey of flue gas desulfurization systems: Lawrence Energy Center, Kansas Power and Light Co. Final report jul-dec 78.** Laseke, B.A. Jr. (PEDCO-Environmental, Inc., Cincinnati, OH (USA)). Aug 1979. Contract EPA-68-02-2603. 123p. NTIS, PC A06/MF A01.

This report describes the results of a survey of operational flue gas desulfurization (FGD) systems on coal-fired utility boilers in the United States. The FGD systems installed on Units 4 and 5 at the Lawrence Energy Center of the Kansas Power and Light Company is described in terms of design and performance. The FGD system installed on each unit consists of two parallel two-stage scrubber modules, each of which includes a rectangular, variable-throat rod-deck venturi scrubber arranged in series with a spray tower absorber. Each system is also equipped with slurry-hold tanks, mist eliminators, and in-line reheaters, as well as isolation and bypass dampers. The two systems share a common limestone storage and preparation facility and waste-disposal facility. These FGD systems represent a second generation design replacement of limestone furnace-injection and tail-end scrubbing systems which were originally installed on Units 4 and 5 in 1968 and 1971, respectively. The original systems operated approximately 27,000 hours and 23,000 hours on coal-fired flue gas for Units 4 and 5, respectively. The redesigned FGD system on Unit 4 went into service in early January 1977. The Unit 5 FGD system went into service on April 14, 1978.

38094 (PB—80-126279) **Survey of flue gas desulfurization systems: Duck Creek Station, Central Illinois Light Co. Final report, Jul-Dec 1978.** Laseke, B.A. Jr. (PEDCO-Environmental, Inc., Cincinnati, OH (USA)). Aug 1979. Contract EPA-68-02-2603. 93p. NTIS, PC A05/MF A01.

The report presents the results of a survey of operational flue gas desulfurization (FGD) systems on coal-fired utility boilers in the United States. The FGD system installed on Unit 1 at the Duck Creek Station of Central Illinois Light Company is described in terms of design and performance. The system consists of four parallel, wet-limestone, rod-deck scrubber modules designed for 25% capacity each, providing a total sulfur dioxide removal efficiency of 85%. The bottom ash, fly ash, and scrubbing wastes are disposed of in a sludge pond lined with a natural impermeable material. The first module of this four module FGD system was placed in service on July 1, 1976, and operated intermittently throughout the remainder of the year and for approximately one month in early 1977. On July 23, 1978, the three remaining modules were completed and all four modules were placed in the gas path for treatment of high sulfur flue gas.

38095 (PB—80-126287) **Survey of flue gas desulfurization systems: Sherburne County Generating Plant, Northern States Power Co. Final report, Jul-Dec 1978.** Laseke, B.A. Jr. (PEDCO-Environmental, Inc., Cincinnati, OH (USA)). Aug 1979. Contract EPA-68-02-2603. 121p. NTIS, PC A06/MF A01.

This report gives results of a survey of operational flue gas desulfurization (FGD) systems on coal-fired utility boilers in the United States. The FGD systems installed on Units 1 and 2 at the Sherburne County Generating Station of the Northern States Power Company is described in terms of design and performance. Each unit is equipped with an alkaline fly ash/limestone two-stage wet scrubbing system for the control of particulate and sulfur dioxide. Each FGD system includes 12 modules, 11 of which are required for full-load operation. The flue gas cleaning wastes are forcibly oxidized, concentrated in a thickener, and discharged for final disposal in a plant-site clay-lined settling pond. The Sherburne 1 and 2 systems were certified commercial on May 1, 1976 and April 1, 1977 respectively. Operation has been accompanied by a number of problems, most of which have been or are being resolved through system design modifications. Designed for a minimum availability of 90%,

the modifications have increased availabilities to the low to mid 90 percent range. The systems have demonstrated compliance with particulate and sulfur dioxide emission regulations.

38096 (PB—80-126295) **Survey of flue gas desulfurization systems: Bruce Mansfield Station, Pennsylvania Power Co. Final report, Jul-Dec 1978.** Laseke, B.A. Jr. (PEDCO-Environmental, Inc., Cincinnati, OH (USA)). Aug 1979. Contract EPA-68-02-2603. 123p. NTIS, PC A06/MF A01.

This report gives the results of a survey of operational flue gas desulfurization (FGD) systems on coal-fired utility boilers in the United States. The FGD systems installed on Units 1 and 2 at the Bruce Mansfield Station of the Pennsylvania Power Company are described in terms of design and performance. Each unit is fitted with a wet magnesium-modified lime scrubbing system consisting of six parallel, two-stage scrubbing trains arranged in two groups of three. Flue gas from each group of three scrubbing trains flows together into an oil-fired reheater and is discharged through a separate flue contained in a 290 m (950 ft) stack. The waste disposal system is a three-part process consisting of a pumping and treatment facility, transportation facility, and containment area. Bruce Mansfield 1 commenced commercial operation on June 1, 1976. Bruce Mansfield 2 commenced commercial operation on October 1, 1977. Initial operation of these FGD systems was characterized by problems with the reheaters, induced-draft fan housing, and stack flue liners.

38097 (UCRL—52989) **Evolution of particulate emissions from a coal-fired power plant.** Buckholtz, H.T.Y. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 15 Aug 1980. Contract W-7405-ENG-48. 179p. NTIS, PC A09/MF A01.

Thesis.

A numerical model has been developed for the dispersal of aerosols downwind from a coal-fired power plant. The main goals were to evaluate with a mathematical simulation the evolution of the spatial extent and particle size distribution of the aerosol material and to predict settling rates affecting the surface environment in the downwind path. The hot air plume coming out of the power plant stack includes a large quantity of aerosol particles. The plume rises with initial upward emission speed until it reaches thermal and kinetic equilibria with the ambient air, then it is transported by the wind current. The plume disperses vertically and horizontally by wind turbulence. In the model particulate coagulation is mathematically described by Timiskii's equation. The relevant semi-empirical work of Smirnov is incorporated to provide the coagulation constant. Because of coagulation, the concentrations of different sizes of aerosol particles in the plume are changed. The numerical simulation studies the importance of particulate coagulation and turbulent dispersion on the downwind plume profile. The downwind transport of the aerosol particles is described by Fick's diffusion equation with the Brownian diffusion coefficient replaced by the turbulent diffusion coefficient. Particle sedimentation is incorporated into the diffusion equation as a first-order differential term. The transport equation is solved by an unconditionally stable finite difference method. At 20 miles downwind, most of the particles with diameter larger than 10 μm have settled to the ground. The size distribution is still bimodal. The distribution of larger particles remains almost unchanged, except for the departure of the super-micronic particles, because coagulation losses are approximately balanced by coagulation gains.

SITE SELECTION AND LAND USE

REFER ALSO TO CITATION(S) 38674

38098 **Diversity of small mammals in a powerline right-of-way and adjacent forest in East Tennessee.** Johnson, W.C. (Virginia Polytechnic Inst. and State Univ., Blacksburg); Schreiber, R.K.; Burgess, R.L. *Am. Midl. Nat.;* 231-235(1979).

One year of trapping along a powerline right-of-way (ROW) in E Tennessee showed that diversity (H') of small mammals was highest in edge and ROW communities. Diversity was almost identical for ROW communities bordered by either pine or hardwood forest, suggesting that the composition of the adjacent forest has little or no effect on the diversity of small mammals inhabiting the ROW. Diversity in hardwood forest and edge was lower than in pine forest and edge.

POWER TRANSMISSION AND DISTRIBUTION

REFER ALSO TO CITATION(S) 37874, 38057, 38246, 38248

38099 (PB—80-125669) **A monitor unit for automatically logging power line disturbances. Technical report.** Kemp, W.M. (Electronics Research Lab., Adelaide (Australia)). Sep 1979. 37p. NTIS, PC A03/MF A01.

A portable monitor system has been developed for automatically gathering data on the quality of electrical mains supplies. The equipment will store the number of times overvoltages or undervoltages occur in a chosen period, and will give a breakdown of the data into five disturbance-duration categories, plus an indication of the accumulated disturbance time. The equipment is self-contained and requires no attention during the monitoring period, making it particularly useful for remote or unmanned sites. Up to 100 000 excursions outside the preset thresholds can be tallied in any one period. The unit will continue to acquire and store data through extended mains failures for virtually the shelf life of its internal battery.

38100 (PB—80-126717) **Physical processes in the contamination flashover of high voltage insulation. Part 1: Appendices A, B, C, and D. Final report, 1 Jun 1972-1 Jun 1975.** Wilson, G.L.; Jolly, D.C. (Massachusetts Inst. of Tech., Cambridge (USA). Electric Power Systems Engineering Lab.). Jun 1975. 221p. NTIS, PC A10/MF A01.

Research performed at M.I.T. on physical processes involved in contamination flashover of outdoor transmission line insulation is reported. The research was directed at obtaining a fundamental understanding of the flashover process in order to suggest improvements in the design of insulators. Contamination flashover is a form of sparkover caused by the formation of a moist conducting film on the surfaces of insulators. It occurs mostly in coastal regions and in industrial regions with air pollution. Research was conducted in three principal areas: collection of basic experimental data on the flashover process, theoretical modeling, and the application of results to prevent flashover. Results include two patent applications, one published paper, one conference paper presentation, and several additional papers submitted for publication. Two seminars were held during the study to which industry representatives were invited. An extensive appendix includes internal memoranda reporting various aspects of the project.

38101 (PB—80-126725) **Physical processes in the contamination flashover of high voltage insulation. Part 2: Appendices E, F, and G. Final report.** Otten, D.M.; King, D.J.; Los, E.J. (Massachusetts Inst. of Tech., Cambridge (USA). Electric Power Systems Engineering Lab.). Jun 1975. 250p. NTIS, PC A11/MF A01.

Measurement of arc tip propagation velocities on the surface of an electrolyte solution (sodium chloride) is described. This study is part of a comprehensive investigation of contamination flashover on high voltage insulators. Experiments were conducted with a photoelectric detector and a streak camera over a wide range of electrolyte conductivities and applied voltages. Experimental details are described and illustrated with diagrams and photographs. The photoelectric detector consists of phototransistors located beneath the electrolyte. It was used to measure arc position at low current levels where the streak camera was not adequate. Part of the data collected appear to be at variance with some presently held theories, but no flaws in the measuring techniques have been found to date, leading to the assumption that the results represent an actual phenomenon. The data collected will be used for theoretical modeling of contamination flashover of high volage power line insulators and should prove useful in understanding the arc propagation mechanism.

38102 (PB—80-126733) **Physical processes in the contamination flashover of high voltage insulation. Part 3: Appendix H. Final report.** Cheng, T. (Massachusetts Inst. of Tech., Cambridge (USA). Electric Power Systems Engineering Lab.). Jun 1975. 242p. NTIS, PC A11/MF A01.

Results of experimental studies of the physical mechanisms responsible for the occurrence of contamination flashovers in high voltage insulators are reported. Contamination flashover is a form of arc discharge across the moist surface of an insulator. The thesis reviews previous studies and presents comprehensive treatments of the following aspects: (1) one-dimensional simulation of a contaminated insulator-linear model, (2) two-dimensional simulation of a contaminated insulator - the flat-plate, (3) surface effects of flashover phenomenon, and (4) high-speed photographic studies of flashovers. The appendix includes computer programs for Dynamic Theories I and II, cathode fall region simulation, and flat-plate simulations. Results of these studies definitely establish the importance of the arc tip region and of the surface condition in causing contamination flashovers. They constitute the basis of suggestions for improving insulator performance. Bibliographies are included for four of the sections.

AC SYSTEMS, EHV AND UHV

38103 (DOE/ET/29343—2) **Development of non-cellulosic insulation for transformers. Quarterly report No. 2, April 1980. General Electric No. CCR-80-07.** Fessler, W.A. (General Electric Co., Pittsfield, MA (USA). Large Transformer Business Div.). 1980. Contract AC02-79ET29343. 34p. NTIS, PC A03/MF A01.

Work has continued on the development of an analytical model to demonstrate the advantages in both materials and losses to be gained by the utilization of thin insulation in transformers. Measurement of mechanical and electrical properties of film materials is underway. The aging and material compatibility of synthetic films in transformer oil, silicone, and R113 is being studied in a sealed-tube aging program. Several materials are on test and others are being readied for test.

38104 (DOE/ET/29343—3) **Development of non-cellulosic insulation for transformers. Quarterly report No. 3, July 1980. General Electric No. CCR-80-16.** Fessler, W.A. (General Electric Co., Pittsfield, MA (USA). Large Transformer Business Div.). 1980. Contract AC02-79ET29343. 77p. NTIS, PC A05/MF A01.

Work is nearly completed on an analytical model to demonstrate the advantages in both materials and losses to be gained by the utilization of thin insulation in transformers. Strip coating studies are under way. The measurement of the physical properties of film is completed and the measurement of electrical properties is nearing completion. The aging and compatibility studies are continuing.

38105 (DOE/RG/06674—01) **Outages of electric power supply resulting from cable failures Boston Edison Company system.** (Commonwealth Associates, Inc., Jackson, MI (USA)). Jul 1980. Contract AC01-78RG06674. 198p. NTIS, PC A09/MF A01.

Factual data are provided regarding 5 electric power supply interruptions that occurred in the Boston Metropolitan area during April to June, 1979. Common to all of these outages was the failure of an underground cable as the initiating event, followed by multiple equipment failures. There was significant variation in the voltage ratings and types of cables which failed. The investigation was unable to delineate a single specific Boston Edison design operating or maintenance practice that could be cited as the cause of the outages. After reviewing the investigative report the following actions were recommended: the development and implementation of a plan to eliminate the direct current cable network; develop a network outage restoration plan; regroup primary feeder cables wherever possible to minimize the number of circuits in manholes, and to separate feeders to high load density areas; develop a program to detect incipient cable faults; evaluate the separation of the north and south sections of Back Bay network into separate networks; and, as a minimum, install the necessary facilities to make it possible to re-energize one section without interfering with the other; and re-evaluate the cathodic protection scheme where necessary. (LCL)

38106 (EPRI-EL—1519) **Development of 345-kV capacitive-graded joint. Final report.** Allam, E.M. (Phelps Dodge Cable and Wire Co., Yonkers, NY (USA)). Sep 1980. Contract AC01-76ET29267. 145p. NTIS, PC A07/MF A01.

The design of a 345-kV prefabricated capacitive-graded joint for oil-filled cables and the manufacture and testing of prototype joints are described. Tests on prototype No. 4 demonstrated the adequacy of the printed circuit design. It was not possible to consistently obtain high-quality capacitive sheets and substantial effort is required to remedy this problem. Advantages of these prefabricated joints are summarized, and specific recommendations are made for further development of the concept.

38107 (PB—80-125610) **Field tests of the Liberty-Mead transmission system.** Eilts, L.E. (Bureau of Reclamation, Denver, CO (USA). Engineering and Research Center). Aug 1979. 61p. NTIS, PC A04/MF A01.

Summarized are results of the October 1977 field tests of the 383-km(238-mi), 345-kV, series-capacitor-compensated Liberty-Mead transmission line of the Western Area Power Administration. The test series included routine capacitor bypass and insertion tests, line switching tests, and staged-fault tests. Principal results are presented in several figures, tables, and oscillograms. The tests demonstrated that routine capacitor bypass and insertion do not adversely affect the power system; line switching surges are modest, but reclosing, using the existing switchgear, is precluded by trapped charge; high-speed capacitor bypass was achieved but reinsertion proceeded slower than permitted by the specifications; breaker interrupting performance was acceptable; and, excepting some minor problems that were identified, the line relaying schemes generally performed satisfactorily.

DC SYSTEMS

REFER ALSO TO CITATION(S) 38105

38108 (DOE/ET/29187—T7) **Liquid metal plasma valve development.** (Hughes Research Labs., Malibu, CA (USA)). Jun 1978. Contract AC01-76ET29187. 221p. NTIS, PC A10/MF A01.

A program for the development of liquid-metal plasma valves (LMPVs) is discussed in detail. The program consisted of two tasks. The first was the development and testing of valves in the laboratory and the fabrication, instrumentation, testing and in-service operation of two valves at the Bonneville Power Adminstration (BPA) facilities of the Pacific Intertie HVDC Power Tansmission System at Celilo, Oregon. The second task was the design, development, fabrication, installation, and operation of a voltage and current monitoring station and the transient event recording system to go with it. Information is present on the design and development of converter valves; LMPV principles; and the testing of prototype valves. (LCL)

38109 (DOE/RA/50153—1) **Study of electric field and ion effects on HVDC lines.** Comber, M.G.; Johnson, G.B. (General Electric Co., Pittsfield, MA (USA)). 1980. Contract AC02-80RA50153. 30p. NTIS, PC A03/MF A01.

Progress is reported in research on the electric field and ion effects of bipolar HVDC transmission lines with voltages up to 1500 kV and on the space charge generation characteristics of different types of conductors for HVDC transmission. (LCL)

38110 (EPRI-EL—1545) **Bipolar dc transmission research above +- 600 kV at project UHV. Final report.** Zaffanella, L.E.; Comber, M.G.; Lloyd, K.J. (General Electric Co., Pittsfield, MA (USA)). Sep 1980. 58p. NTIS, PC A04/MF A01.

The high-voltage direct-current (HVDC) bipolar research facilities, adapted from existing ac testing facilities at Project UHV, that were constructed to study and to provide future design information for overhead dc transmission lines in the +- 600 to +- 1500-kV range are examined. A description of the new power supply equipment and a study of the requirements of the power supply for flashover tests on HVDC insulators are included.

38111 (PB—80-127350) **A new control method for multiterminal dc transmission.** Nozari, F.; Carroll, D.P. (Purdue Univ., Lafayette, IN (USA). School of Electrical Engineering). 1976. 10p. NTIS, PC A02/MF A01.

A new control scheme for parallel multiterminal dc systems is proposed. The scheme is divided into two separate functions: a supervisory control called the Systems Monitor-State Predictor (SMSP), which determines the steady state operating point of the system from ac volage measurements, power requirements at the converters, and the dc network configuration; and the feedback controllers which drive the system to the desired operating point supplied by the SMSP. A systematic method is presented for calculating local feedback gains based on optimal control theory. It is shown that the use of feedback measurements is possible with negligible loss of dynamic performance. A detailed hybrid computer simulation of a four-terminal dc system is used to demonstrate the performance of the new control scheme during steady state operation and for large system disturbances. It has advantages in speed and flexibility over the conventional approach through its use of system voltage measurements. The method can be implemented as an on-line control using a small central computer.

SUPERCONDUCTING AND CRYOGENIC SYSTEMS

38112 (PB—80-130800) **Control of high voltage discharges in vacuum insulated cryocables. Stage 2. Interim report, Jul 1974-Mar 1975.** (Massachusetts Inst. of Tech., Cambridge (USA). Francis Bitter National Magnet Lab.). Apr 1975. Contract NSF-C670. 23p. NTIS, PC A02/MF A01.

Progress is reported on a project dealing with discharges and other ionic effects produced by the 60 Hz magnetic field in the high voltage vacuum insulation of cryocables. A short loop of coaxial cryocable equipped with voltage and current transformers for circulation of 250 MW of power was built to simulate interaction of the magnetic field encircling the current-carrying conductor. The design of the loop is described and illustrated together with capacitance and heat leak measurement and design options. The loop, which is installed in the M.I.T. cryocable laboratory, was designed to increase the demonstrated single-phase cryocable transmission capability six-fold. Preliminary experiments have been conducted on the interaction of axial dc magnetic fields with 60 Hz and dc radial electric fields. Results of these preliminary experiments are summarized, including the passage of 200 MW of power around the short coaxial cryocable loop. This is over five times as much power as previously achieved with cryocables and almost three times the single-phase capability of a conventional 138 kV pipe-type cable.

NUCLEAR POWER PLANTS

38113 (ORNL/TM—7425) **Overview paper on nuclear power.** Spiewak, I.; Cope, D.F. (Oak Ridge National Lab., TN (USA)). Sep 1980. Contract W-7405-ENG-26. 244p. NTIS, PC A11/MF A01.

This paper was prepared as an input to ORNL's Strategic Planning Activity, ORNL National Energy Perspective (ONEP). It is intended to provide historical background on nuclear power, an

analysis of the mission of nuclear power, a discussion of the issues, the technology choices, and the suggestion of a strategy for encouraging further growth of nuclear power.

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, BOILING WATER COOLED

REFER ALSO TO CITATION(S) 37704, 38181, 38183, 38184, 38185, 38191, 38198, 38199

38114 (CONF-800942—10) **Developments in sensitivity theory.** Cacuci, D.G.; Greenspan, E.; Marable, J.H.; Williams, M.L. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 13p. NTIS, PC A02/MF A01.

From ANS topical meeting on 1980 advances in reactor physics and shielding; Sun Valley, ID, USA (14 Sep 1980).

A review of recent developments in sensitivity theory is presented with an emphasis on (a) extensions to new areas such as thermal hydraulics, reactor depletion, multi-constraint and extrema problems, and (b) recent mathematical refinements to and extensions of the basic theory. The diverse new areas of application are discussed from a unified theoretical viewpoint based on nonlinear functional analysis. Several new applications of sensitivity theory are presented for problems in constrained reactor physics calculations, irradiation experiment analysis, reactor burnup calculations, and transient thermal-hydraulic analysis. Future directions of the research are suggested.

38115 (EGG—2056) **Tables of homogeneous equilibrium critical flow parameters for water in SI units.** Hall, D.G.; Czapary, L.S. (EG and G Idaho, Inc., Idaho Falls (USA)). Sep 1980. Contract AC07-76ID01570. 288p. NTIS, PC A12/MF A01.

This reference document presents tables and charts containing data calculated using the homogeneous equilibrium critical flow model (HEM). The ranges of stagnation state properties for which data are presented include: pressures from 2 to 22 120kPa, temperatures from 290 to 640 K, and thermodynamic qualities from 0 to 1.

38116 (EGG-PHYS—5239) **Progressive Conversion Reactor (PCR): a uranium conserving proliferation resistant concept.** Leyse, C.F.; Judd, J.L. (Idaho National Engineering Lab., Idaho Falls (USA)). Sep 1980. Contract AC07-76ID01570. 102p. NTIS, PC A06/MF A01.

This report provides the results of preliminary investigations into the potential improvements in uranium utilization and proliferation resistance that may be achieved with the Progressive Conversion Reactor (PCR), an unconventional approach to the design and operation of boiling waer reactors. The purpose of the preliminary studies was to determine if the PCR concept is sufficiently attractive to warrant a thorough feasibility study of the concept to delineate its advantages, disadvantages and potential for timely commercialization. Neutronic analyses have been conducted of commercial size PCR-type reactors fueled with low enriched uranium (LEU), 20% enriched uranium in thorium (MEU/thorium) and uranium 233 in thorium (U233/thorium). The studies of the LEU, and MEU/thorium fueled reactors were directed primarily at utilization of the once-through fuel cycle in which spent reactor fuel is not reprocessed and recycled. Compared to use of these fuels in conventional LWRs, substantial gains in uranium utilization and proliferation resistance are indicated for the PCR concept.

38117 (SAND—80-0631C) **Decay heat removal systems: design criteria and options.** Berry, D.L. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 19p. (CONF-801056—3). NTIS, PC A02/MF A01.

From International conference on current nuclear power plant safety issues; Stockholm, Sweden (26 Oct 1980).

Design criteria and alternate decay heat removal system concepts which have evolved in several different countries throughout the world were compared. The conclusion was reached that the best way to improve the reliability of pressurized water reactor (PWR) decay heat removal is first to focus on improving the reliability of the auxiliary feedwater and high pressure injection systems to cope with certain loss of feedwater transients and small loss of coolant accidents and then to assess how well these systems can handle special emergencies (e.g., sabotage, earthquake, airplane crash). For boiling water reactors (BWRs), it was concluded that emphasis should be placed first on improving the reliability of the residual heat removal and high pressure service water systems to cope with a loss of suppression pool cooling following a loss of feedwater transient and then to assess how well these systems can handle special emergencies. It was found that, for both PWRs and BWRs, a design objective for alternate decay heat removal systems should be at least an order of magnitude reduction in core meltdown probability.

38118 (SAND—80-2039C) **Physical protection solutions for security problems at nuclear power plants.** Darby, J.L.; Jacobs, J. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1980. Contract AC04-76DP00789. 24p. (CONF-801026—4). NTIS, PC A02/MF A01.

From ANS workshop on power plant security; Chicago, IL, USA (5 Oct 1980).

Under Department of Energy sponsorship, Sandia National Laboratories has developed a broad technological base of components and integrated systems to address security concerns at facilities of importance, including nuclear reactors. The primary security concern at a light water reactor is radiological sabotage, a deliberate set of actions at a plant which could expose the public to a significant amount of radiation (on the order of 10 CFR 100 limits). (Also of importance to plant operators are acts of industrial sabotage that could prevent a plant from producing electrical power).

38119 (SAND—80-2167C) **Filtered-vented containment systems.** Benjamin, A.S.; Walling, H.C.; Cybulskis, P.; DiSalvo, R. (Sandia National Labs., Albuquerque, NM (USA); Battelle Columbus Labs., OH (USA); Nuclear Regulatory Commission, Washington, DC (USA)). 1980. Contract AC04-76DP00789. 24p. (CONF-801056—2; IAEA-CN—39/103). NTIS, PC A02/MF A01.

From International conference on current nuclear power plant safety issues; Stockholm, Sweden (26 Oct 1980).

The potential benefits of filtered-vented containment systems as a means for mitigating the effects of severe accidents are analyzed. Studies so far have focused upon two operating reactor plants in the United States, a large-containment pressurized water reactor and a Mark I containment boiling water reactor. Design options that could be retrofitted to these plants are described including single-component once-through venting systems, multiple-component systems with vent and recirculation capabilities, and totally contained venting systems. A variety of venting strategies are also described which include simple low-volume containment pressure relief strategies and more complicated, high-volume venting strategies that require anticipatory actions. The latter type of strategy is intended for accidents that produce containment-threatening pressure spikes.

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, NON-BOILING WATER COOLED

REFER ALSO TO CITATION(S) 37704, 38114, 38115, 38117, 38118, 38119, 38150, 38163, 38164, 38180, 38181, 38182, 38183, 38184, 38185, 38186, 38187, 38188, 38189, 38190, 38191, 38192, 38194, 38195, 38196, 38198, 38199, 38200, 38517, 38708

38120 (COO—2974-2) **Acoustic monitoring systems tests at Indian Point Unit 1. Final report.** Smith, J.R.; Rao, G.V.; Craig, J. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Nuclear Energy Systems Div.). Dec 1979. Contract AC02-76ET34201. 104p. NTIS, PC A06/MF A01.

This report describes the results of a program to test acoustic monitoring systems on Indian Point Unit No. 1 under actual plant operating conditions, less the reactor core. The two types of systems evaluated were the monitoring of acoustic emissions generated by growing flaws and the monitoring of acoustic signals from leaks.

38121 (EPRI-NP—1509) **Improvements to the COBRA-TF (EPRI) computer code for steam generator analysis. Final report.** Stewart, C.W.; Barnhart, J.S.; Koontz, A.S. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Sep 1980. Contract AC06-76RL01830. 115p. NTIS, PC A06/MF A01.

The COBRA-TF (EPRI) code has been improved and extended for pressurized water reactor steam generator analysis. New features and models have been added in the areas of subcooled boiling and heat transfer, turbulence, numerics, and global steam generator modeling. The code's new capabilities are qualified against selected experimental data and demonstrated for typical global and microscale steam generator analysis.

38122 (UCID—18676) **Technical evaluation of the proposed technical specification change for the Arkansas Nuclear Power Station, Unit 2.** Victor, R.A. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). Aug 1980. Contract W-7405-ENG-48. 16p. NTIS, PC A02/MF A01.

This report documents the technical evaluation of the request for changes in the Technical Specifications for the Arkansas Nuclear Power Station, Unit 2. These changes were proposed by the licensee in a letter dated November 27, 1979. The basis for review included a report entitled Determination of Plant System Trip Setpoints Valves. The requested changes to the Technical Specifications were found to be acceptable based on information submitted by the licensee.

38123 (UCRL—50025-80-1, pp 10-16) **LLNL assists in technical review of low-temperature overpressurization protection systems in pressurized water reactors.** 1 Apr 1980.

In Electronics Engineering Department. Quarterly report No. 1, 1980.

Because some pressurized water reactors have sustained pressure transients during low-temperature operation, NRC has asked LLNL and EG & G to review technically the design and implementation of low-temperature overpressurization protection systems in pressurized water reactors.

38124 (LA-tr—80-5) **Studies and accomplishments with regard to instrumentation for monitoring and controlling of nuclear boilers.** Douet, P.; Duchene, J.; Dumesnil, P.; Jover, P.; Plaige, Y.; Verdant, R. Translated from *Bull. Inf. Sci. Tech. (Paris);* No. 213, 79-86(1976). 19p. NTIS, PC A02/MF A01.

The radiation detector and electronic equipment developments for fuel failure detection in PWR type reactors are described. The testing of boron concentration measuring equipment is reviewed.

POWER REACTORS, NON-BREEDING, GRAPHITE MODERATED

REFER ALSO TO CITATION(S) 38151, 38152, 38153, 38159, 38160, 38193, 38376

38125 (GA-A—15684) **High-temperature gas-cooled reactor helium compatibility studies: results of 10,000-hour exposure of selected alloys in simulated reactor helium.** Lechtenberg, T.A.; Stevenson, R.D.; Johnson, W.R. (General Atomic Co., San Diego, CA (USA)). May 1980. Contract AT03-76ET35300. 217p. NTIS, PC A10/MF A01.

Work on the HTGR Helium Compatibility Task accomplished during the period March 31, 1977 through September 30, 1979, is documented in this report. Emphasis is on the results and analyses of creep data to 10,000 h and the detailed metallurgical evaluations performed on candidate alloy specimens tested for up to 10,000 h. Long-term creep and unstressed aging data in controlled-impurity helium and in air at 800, 900, and 1000°C are reported for alloys included in the program in FY-76, including the wrought solid-solution-strengthened alloys, Hastelloy X, Hastelloy S, RA 333, and HD 556, and the centrifugally cast austenitic alloys, HK 40, Supertherm, Manaurite 36X, Manaurite 36XS, and Manaurite 900.

38126 (GA-A—15715) **HTGR-GT systems optimization studies.** Kammerzell, L.L.; Read, J.W. (General Atomic Co., San Diego, CA (USA)). Jun 1980. Contract AT03-76SF70046. 12p. (CONF-801102—25). NTIS, PC A02/MF A01.

From ASME winter annual meeting; Chicago, IL, USA (16 Nov 1980).

The compatibility of the inherent features of the high-temperature gas-cooled reactor (HTGR) and the closed-cycle gas turbine combined into a power conversion system results in a plant with characteristics consistent with projected utility needs and national energy goals. These characteristics are: (1) plant siting flexibility; (2) high resource utilization; (3) low safety risks; (4) proliferation resistance; and (5) low occupational exposure for operating and maintenance personnel. System design and evaluation studies on dry-cooled intercooled and nonintercooled commercial plants in the 800-MW(e) to 1200-MW(e) size range are described, with emphasis on the sensitivity of plant design objectives to variation of component and plant design parameters. The impact of these parameters on fuel cycle, fission product release, total plant economics, sensitivity to escalation rates, and plant capacity factors is examined.

38127 (GA-A—15863) **Medium-size high-temperature gas-cooled reactor.** Peinado, C.O.; Koutz, S.L. (General Atomic Co., San Diego, CA (USA)). Aug 1980. Contract AT03-76ET35301. 30p. (CONF-800578—2). NTIS, PC A03/MF A01.

From Conference on the utilization of small and medium size power reactors in Latin America; Montevideo, Uruguay (12 May 1980).

This report summarizes high-temperature gas-cooled reactor (HTGR) experience for the 40-MW(e) Peach Bottom Nuclear Generating Station of Philadelphia Electric Company and the 330-MW(e) Fort St. Vrain Nuclear Generating Station of the Public Service Company of Colorado. Both reactors are graphite moderated and helium cooled, operating at ~ 760°C (1400°F) and using the uranium/thorium fuel cycle. The plants have demonstrated the inherent safety characteristics, the low activation of components, and the high efficiency associated with the HTGR concept. This experience has been translated into the conceptual design of a medium-sized 1170-MW(t) HTGR for generation of 450 MW of electric power. The concept incorporates inherent HTGR safety characteristics [a multiply redundant prestressed concrete reactor vessel (PCRV), a graphite core, and an inert single-phase coolant] and engineered safety features (core auxiliary cooling, relief valve, and steam generator dump systems).

38128 (GA-A—15885) **Hot helium flow test facility summary report.** (General Atomic Co., San Diego, CA (USA)). Jun 1980. Contract AT03-76ET35300. 34p. NTIS, PC A03/MF A01.

This report summarizes the results of a study conducted to assess the feasibility and cost of modifying an existing circulator test facility (CTF) at General Atomic Company (GA). The CTF originally was built to test the Delmarva Power and Light Co. steam-driven circulator. This circulator, as modified, could provide a source of hot, pressurized helium for high-temperature gas-cooled reactor (HTGR) and gas-cooled fast breeder reactor (GCFR) component testing. To achieve this purpose, a high-temperature impeller would be installed on the existing machine. The projected range of tests which could be conducted for the project is also presented, along with corresponding cost considerations.

38129 (GA-A—15929) **Strength and fracture characteristics of HTGR thermal barrier ceramics.** Sheehan, J.E.; Holzgraf, J.F. (General Atomic Co., San Diego, CA (USA)). Aug 1980. Contract AT03-76ET35300. 126p. NTIS, PC A07/MF A01.

The design of core support pads and cover blocks for the high-temperature gas-cooled reactor (HTGR) requires a detailed knowledge of the structural integrity of commercial ceramics. This report gives the baseline strengths and fractography of candidate Al_2O_3, Si_3N_4, and fused SiO_2 materials. Diametral-compressive and four-point bend strengths were determined between 20° to 1200°C in dry helium. Chemistry, microstructure, and fracture surfaces were correlated with the mechanical behavior.

POWER REACTORS, NON-BREEDING, OTHERWISE MODERATED OR UNMODERATED

REFER ALSO TO CITATION(S) 38161

POWER REACTORS, BREEDING

REFER ALSO TO CITATION(S) 38114, 38128, 38172, 38183, 38197

38130 (BNL—28095) **Improved fission product model for fast reactor analysis.** Atefi, B.; Fischer, G.J.; Durston, C. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 5p. (CONF-801107—9). NTIS, PC A02/MF A01.

From ANS international conference; Washington, DC, USA (17 Nov 1980).

A new and highly effective procedure for generating fission product cross sections for LMFBR studies has been developed. The resultant simplified cross sections agree with more detailed treatments to within a few percent, and thus, are particularly valuable for fuel cycle and other studies. The proposed model consists of a two-lump fission product set, one based on the odd-A fission products and the other based on the even-A fission products with transmutation between the odd and even-A isotopes through capture. To examine the behavior of the proposed odd-even model, a detailed burnup analysis of 181 fission product elements in 84 chains was performed using the fission product code EPRI-CINDER. A 154-group fission product cross-section library generated from the ENDFB/4 library was used as the basic cross-section library. These cross sections were collapsed to a four-group set suitable for use in CINDER using two spectra, one representative of the soft spectrum zones and the other representative of the hard spectrum zones of the FMSR. The analysis was performed for Pu-239, U-235 and U-238 fission in both spectra.

38131 (BNL—28288) **Breeder design for enhanced performance and safety characteristics.** Fischer, G.J.; Atefi, B.; Yang, J.W.; Galperin, A.; Segev, M. (Brookhaven National Lab., Upton, NY (USA); Ben-Gurion Univ. of the Negev, Beersheba (Israel)). 1980. Contract AC02-76CH00016. 12p. (CONF-800942—12). NTIS, PC A02/MF A01.

From ANS topical meeting on 1980 advances in reactor physics and shielding; Sun Valley, ID, USA (14 Sep 1980).

A fast breeder reactor design has been created which offers a considerably extended fuel cycle and excellent performance characteristics. An example of a core designed to operate on a ten-year fuel cycle is described in some detail. Use of metal fuel along with a moderator such as beryllium oxide dispersed throughout the core provides both design flexibility and safety advantages such as a strong Doppler feedback and limited sodium void reactivity gain. Local power variations are small for the entire cycle; control requirements are also modest, and fuel cycle costs are low.

38132 (CONF-800967—1) **RODCON: a finite difference heat conduction computer code in cylindrical coordinates.** Conklin, J.C.

(Oak Ridge National Lab., TN (USA)). 16 Sep 1980. Contract W-7405-ENG-26. 19p. NTIS, PC A02/MF A01.

From 6. GCFR heat transfer specialist meeting; Berkeley, UK (18 Sep 1980).

RODCON, a finite difference computer code, was developed to calculate the internal temperature distribution of the fuel rod simulator (FRS) for the Core Flow Test Loop (CFTL). RODCON solves the implicit, time-dependent forward-differencing heat transfer equation in 2-dimensional ($R\theta$) cylindrical coordinates at an axial plane with user specified radial material zones and surface conditions at the FRS periphery. Symmetry of the boundary conditions of coolant bulk temperatures and film coefficients at the FRS periphery is not necessary.

38133 Radionuclide deposition control. Brehm, W.F.; McGuire, J.C. (to Dept. of Energy). US Patent 4,202,730. 13 May 1980. Filed date 18 Jan 1977. 10p.

PAT-APPL-760,302.

A process is described for controlling the deposition or non-deposition of radionuclides ^{54}Mn, ^{58}Co, and ^{60}Co from liquid sdoium used as coolant in a sodium-cooled fast breeder reactor. A high surface area material of nickel or a nickel alloy is positioned in the flow of sodium containing the radionuclides to effect deposition of the radionuclides on the metal surface. Subsequently, the radionuclide loaded material is separated from the sodium stream. In areas where radionuclide deposition is undesirable, the positioning of components having surface areas made of W, Mo, or Ta will prevent or retard deposition. (BLM)

38134 (DOE/ET/37208—T1) **Growth rates of breeder reactor fuel. Final report.** Ott, K.O. (Purdue Research Foundation, Lafayette, IN (USA)). 1979. Contract AS02-76ET37208. 5p. NTIS, PC A02/MF A01.

During the contract period, a consistent formalism for the definition of the growth rates (and thus the doubling time) of breeder reactor fuel has been developed. This formalism was then extended to symbiotic operation of breeder and converter reactors. Further, an estimation prescription for the growth rate has been developed which is based upon the breeding worth factors. The characteristics of this definition have been investigated, which led to an additional integral concept, the breeding bonus.

38135 (GA-A—15894) **GCFR steam generator conceptual design.** Holm, R.A.; Elliott, J.P. (General Atomic Co., San Diego, CA (USA)). 1980. Contract AT03-76SF71023. 24p. (CONF-800648—16). NTIS, PC A02/MF A01.

From GCFRP program technical review meeting; San Diego, CA, USA (4 Jun 1980).

The gas-cooled fast reactor (GCFR) steam generators are large once-through heat exchangers with helically coiled tube bundles. In the GCFR demonstration plant, hot helium from the reactor core is passed through these units to produce superheated steam, which is used by the turbine generators to produce electrical power. The paper describes the conceptual design of the steam generator. The major components and functions of the design are addressed. The topics discussed are the configuration, operating conditions, design criteria, and the design verification and support programs.

38136 (HEDL-SA—1933) **Experience with simplified inelastic analysis of piping designed for elevated temperature service.** Severud, L.K. (Hanford Engineering Development Lab., Richland, WA (USA)). Mar 1980. Contract AC14-76FF02170. 16p. (CONF-800804—27). NTIS, PC A02/MF A01.

From ASME century 2 emerging technology conference; San Francisco, CA, USA (10 Aug 1980).

Screening rules and preliminary design of FFTF piping were developed in 1974 based on expected behavior and engineering judgment, approximate calculations, and a few detailed inelastic analyses of pipelines. This paper provides findings from six additional detailed inelastic analyses with correlations to the simplified analysis screening rules. In addition, simplified analysis methods for treating weldment local stresses and strains as well as fabrication induced flaws are described. Based on the FFTF experience, recommendations for future Code and technology work to reduce design analysis costs are identified.

38137 (HEDL-SA—1955) **Seismic transient analysis of a containment vessel with penetrations.** Dahlke, H.J.; Weiner, E.O. (Hanford Engineering Development Lab., Richland, WA (USA)). Dec 1979. Contract AC14-76FF02170. 34p. (CONF-800804—29). NTIS, PC A03/MF A01.

From ASME century 2 emerging technology conference; San Francisco, CA, USA (10 Aug 1980).

A linear transient analysis of the FFTF containment vessel was conducted with STAGS to justify the load levels used for the seismic qualification testing of the heating and ventiliation valve operators. The modeling consists of a thin axisymmetric shell for the containment vessel with four penetrations characterized by linear and rotational inertias as well as attachment characteristics to the shell. Motions considered are horizontal, rocking and vertical input to the base, and the solution is carried out by direct integration. Results show that the test levels and the approximate analyses considered are conservative. Response spectra for some containment vessel penetrations applicable to the model are presented.

38138 (HEDL-SA—1992-FP) **Insulated pipe clamp design.** Anderson, M.J.; Hyde, L.L.; Wagner, S.E.; Severud, L.K. (Hanford Engineering Development Lab., Richland, WA (USA)). Jan 1980. Contract AC14-76FF02170. 15p. (CONF-800804—31). NTIS, PC A02/MF A01.

From ASME century 2 emerging technology conference; San Francisco, CA, USA (10 Aug 1980).

Thin wall large diameter piping for breeder reactor plants can be subjected to significant thermal shocks during reactor scrams and other upset events. On the Fast Flux Test Facility, the addition of thick clamps directly on the piping was undesired because the differential metal temperatures between the pipe wall and the clamp could have significantly reduced the pipe thermal fatigue life cycle capabilities. Accordingly, an insulated pipe clamp design concept was developed. The design considerations and methods along with the development tests are presented. Special considerations to guard against adverse cracking of the insulation material, to maintain the clamp-pipe stiffness desired during a seismic event, to minimize clamp restraint on the pipe during normal pipe heatup, and to resist clamp rotation or spinning on the pipe are emphasized.

38139 (LA—8489-PR) **Examination of fast reactor fuels and FBR analytical quality assurance standards and methods.** Maraman, W.J. (Los Alamos Scientific Lab., NM (USA)). Aug, 1980. Contract W-7405-ENG-36. 12p. NTIS, PC A12/MF A01.

This is the twenty-third quarterly report on the Examination of Fast Reactor Fuels and Fast Breeder Reactor (FBR) Analytical Quality Assurance and Methods at the Los Alamos Scientific Laboratory. Most of the investigations discussed here are of the continuing type. Results and conclusions described may therefore be changed or augmented as the work continues.

38140 (PNL—3379) **SUPERENERGY-2: a multiassembly, steady-state computer code for LMFBR core thermal-hydraulic analysis.** Basehore, K.L.; Todreas, N.E. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Aug 1980. Contract AC06-76RL01830. 208p. (COO—2245-57TR). NTIS, PC A10/MF A01.

Core thermal-hydraulic design and performance analyses for Liquid Metal Fast Breeder Reactors (LMFBRs) require repeated detailed multiassembly calculations to determine radial temperature profiles and subchannel outlet temperatures for various core configurations and subassembly structural analyses. At steady-state, detailed core-wide temperature profiles are required for core restraint calculations and subassembly structural analysis. In addition, sodium outlet temperatures are routinely needed for each reactor operating cycle. The SUPERENERGY-2 thermal-hydraulic code was designed specifically to meet these designer needs. It is applicable only to steady-state, forced-convection flow in LMFBR core geometries.

38141 (WAPD-TM—1468) **Successive collision calculation of resonance absorption (AWBA Development Program).** Schmidt, E.; Eisenhart, L.D. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Jul 1980. Contract AC11-76PN00014. 35p. NTIS, PC A03/MF A01.

The successive collision method for calculating resonance absorption solves numerically the neutron slowing down problem in reactor lattices. A discrete energy mesh is used with cross sections taken from a Monte Carlo library. The major physical approximations used are isotropic scattering in both the laboratory and center-of-mass systems. This procedure is intended for day-to-day analysis calculations and has been incorporated into the current version of MUFT. The calculational model used for the analysis of the nuclear performance of LWBR includes this resonance absorption procedure. Test comparisons of results with RCP01 give very good agreement.

38142 (DOE-tr—241) **Fast neutron reactors in atomic power engineering.** Kazachkovskiy, O.D. Translated from *Priroda (Moscow)*; 2: 16-25(1980). 17p. (VAAP/DOE—80-001). NTIS, PC A02/MF A01.

Information is included concerning nuclear fuel conversion; the engineering problems of breeder reactors; and the present and future of breeder reactors.

38143 (DOE/CEA/BMFT—6) **Acoustical detection of water leaks in a mock-up of a helicoidal-bundle steam generator. Technical report DRNR/P/N 068.** Fluis, H.; Freycenon, J. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). [nd]. 31p. (In French). NTIS (US Sales Only), PC A03/MF A01.

The study of vibrations of the external wall of a steam-generator mock-up permits detecting a voluntary injection of water into the sodium, simulating a leak. Measurements have shown that

under the test conditions it was possible to detect the induced leak and the appearance of large secondary leaks produced by erosion-corrosion.

38144 (CONF-800942—4) **Analysis of the new GCFR upper and lower plenum flow-through shields.** Cramer, S.N. (Oak Ridge National Lab., TN); Reed, D.A.; Emmett, M.B.; Rouse, C.A. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA); Union Carbide Corp., Oak Ridge, TN (USA). Nuclear Div.; General Atomic Co., San Diego, CA (USA)). [nd]. Contract W-7405-ENG-26. 10p. NTIS, PC A02/MF A01.

From ANS topical meeting on 1980 advances in reactor physics and shielding; Sun Valley, ID, USA (14 Sep 1980).

Analysis of the proposed GCFR upper and lower plenum flow-through shields has been performed using both discrete ordinate (DOT) and Monte Carlo (MORSE) methods. Several shields having one change of direction in the coolant path (chevron) and two changes of direction (herringbone) were investigated. The shields were modeled as unit cells with periodic boundary conditions. From plenum fluence calculations and design constraints at the reactor vessel liner, it was determined that all the shield configurations analyzed should be adequate for the necessary radiation attenuation.

REGULATION AND LICENSING

38145 (CONF-800970—1) **Department of Energy Nuclear Energy Standards Program.** Silver, E.G. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 11p. NTIS, PC A02/MF A01.

From 29. annual conference of the Standards Engineering Society; Minneapolis, MN, USA (23 Sep 1980).

The policy with respect to the development and use of standards in the Department of Energy (DOE) programs concerned with maintaining and developing the nuclear option for the civilian sector (both in the form of the currently used light water reactors and for advanced concepts including the Liquid Metal Fast Breeder Reactor), is embodied in a Nuclear Standards Policy, issued in 1978, whose perspectives and philosophy are discussed.

38146 (PB—80-900200) **Environmental standard review plans for the environmental review of construction permit applications for nuclear power plants, updates.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). 1980. aprox. 25 issuep. Paper copy available on subscription, North American Continent price $60.00/year; all others write for quote. Basic report available as PB80-900299.

This subscription item provides updates to the NRC's environmental standard review plans (ESRPs). These ESRPs are instructions for conducting the environmental review of applications for nuclear power plant construction permits.

38147 (RDT-E—15-2NC-T(6-80)) **Class 2 nuclear components: supplement to ASME Boiler and Pressure Vessel Code, Section III, Subsections NCA and NC.** (Department of Energy, Washington, DC (USA). Office of Nuclear Energy Programs). 20 Jun 1980. Contract W-7405-ENG-26. 30p. RSO.

This standard supplements the rules for the construction of nuclear components that are covered by Subsections NCA and NC of the 1977 Edition of the ASME Boiler and Pressure Vessel Code (the Code), Section III. When this standard is invoked or referenced, the applicable subsections of Section III of the Code are also invoked or referenced. The user is responsible for obtaining and applying the edition and revisions of this standard that supplement the edition and Addenda of the Code that are in legal effect at the time of use.

ECONOMICS

38148 (ORNL/SUB—80/13632/1) **Nuclear energy center finance and ownership considerations.** Morris, J.A.; Wilder, R.P. (Economic Consultants, Columbia, SC (USA)). Sep 1980. Contract W-7405-ENG-26. 54p. NTIS, PC A04/MF A01.

Finance and ownership alternatives for a nuclear energy center (NEC) in South Carolina are analyzed in the context of the capital market and tax differences among alternatives. The ownership alternatives considered are (1) the private or private/public joint venture, (2) full public ownership and (3) a hybrid ownership form featuring federal involvement in the initial site development and permit phase, followed by a transition to private ownership. Public ownership is associated with considerably lower out-of-pocket costs than private ownership; the difference between the two, however, is related to subsidies from other parts of society to electricity customers of a publicly owned NEC. The attitudes of participating utilities on ownership forms are examined, with the finding of general strong opposition to increased federal involvement in the electric utility industry through NEC ownership. The conclusion is that the private-private/public joint venture is the preferable ownership form and that public ownership should be employed only if the private sector fails to respond to future energy demand.

FUEL CYCLE

REFER ALSO TO CITATION(S) 37747, 38116

38149 (DOE/TIC—11264) **NUFACTS-nuclear fuel cycle activity simulator: reference manual. Final report.** Triplett, M.B.; Waddell, J.D.; Breese, T.A. (Battelle Columbus Labs., OH (USA)). 15 Aug 1978. Contract W-7405-ENG-92. 241p. NTIS, PC A11/MF A01.

The Nuclear Fuel Cycle Activity Simulator (NUFACTS) is a package of FORTRAN subroutines which facilitate the simulation of a diversity of nuclear power growth scenarios. An approach to modeling the nuclear fuel cycle has been developed that is highly adaptive and capable of addressing a variety of problems. Being a simulation model rather than an optimization model, NUFACTS mimics the events and processes that are characteristic of the nuclear fuel cycle. This approach enables the model user to grasp the modeling approach rather quickly. Within this report descriptions of the model and its components are provided with several emphases. First, a discussion of modeling approach and basic assumptions is provided. Next, instructions are provided for generating data, inputting the data properly, and running the code. Finally, detailed descriptions of individual program element are given as an aid to modifying and extending the present capabilities.

38150 (ORNL/Sub—7496/1) **Safety analysis of B & W Standard PWR using thorium-based fuels.** Uotinen, V.O.; Carroll, W.P.; Jones, H.M.; Toops, E.C. (Babcock and Wilcox Co., Lynchburg, VA (USA). Power Generation Div.). Jun 1980. Contract W-7405-ENG-26. 210p. (BAW—1609). NTIS, PC A10/MF A01.

A study was performed to assess the safety and licenseability of the Babcock & Wilcox standard 205-fuel assembly PWR when it is fueled with three types of thoria-based fuels denatured ($^{233}U/^{238}U$-Th)O_2, denatured ($^{235}U/^{238}U$-Th)O_2, and (Th-Pu)O_2. Selected transients were analyzed using typical PWR safety analysis calculational methods. The results support the conclusion that it is feasible from a safety standpoint to utilize either of the denatured urania-thoria fuels in the standard B & W plant. In addition, it appears that the use of thoria-plutonia fuels would probably also be feasible. These tentative conclusions depend on a data that is more limited than that available for UO_2 fuels.

PROCESS HEAT REACTORS

38151 (COO—4057-12) **Gas reactor international cooperative program. HTR-synfuel application assessment.** (General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.). Sep 1979. Contract AC02-77ET35202. 393p. NTIS, PC A17/MF A01.

This study assesses the technical, environmental and economic factors affecting the application of the High Temperature Gas-Cooled Thermal Reactor (HTR) to: synthetic fuel production; and displacement of fossil fuels in other industrial and chemical processes. Synthetic fuel application considered include coal gasification, direct coal liquefaction, oil shale processing, and the upgrading of syncrude to motor fuel. A wide range of other industrial heat applications was also considered, with emphasis on the use of the closed-loop thermochemical energy pipeline to supply heat to dispersed industrial users. In this application syngas ($H_2 + CO_2$) is produced at the central station HTR by steam reforming and the gas is piped to individual methanators where typically 1000°F steam is generated at the industrial user sites. The products of methanation ($CH_4 + H_2O$) are piped back to the reformer at the central station HTR.

38152 (DOE/ET/34222—T1) **1170 MW/sub t/ HTGR steamer cogeneration plant: design and cost study.** (United Engineers and Constructors, Inc., Philadelphia, PA (USA)). Aug 1980. Contract AC02-78ET34222. 235p. NTIS, PC A11/MF A01.

A conceptual design and cost study is presented for intermediate size high temperature gas-cooled reactor (HTGR) for industrial energy applications performed by United Engineers and Constructors Inc., (UE and C) and The General Atomic Company (GAC). The study is part of a program at ORNL and has the objective to provide support in the evaluation of the technical and economic feasibility of a single unit 1170 MW/sub t/ HTGR steam cycle cogeneration plant (referred to as the Steamer plant) for the production of industrial process energy. Inherent in the achievement of this objective, it was essential to perform a number of basic tasks such as the development of plant concept, capital cost estimate, project schedule and annual operation and maintenance (O and M) cost.

38153 (GA-A—16052) **High temperature heat exchange: nuclear process heat applications.** Vrable, D.L. (General Atomic Co., San Diego, CA (USA)). Sep 1980. Contract AT03-76SF71061. 11p. (CONF-800983—1). NTIS, PC A02/MF A01.

From Joint Japan/US heat transfer seminar; Tokyo, Japan (29 Sep 1980).

The unique element of the HTGR system is the high-temperature operation and the need for heat exchanger equipment to transfer nuclear heat from the reactor to the process application. This paper discusses the potential applications of the HTGR in both synthetic fuel production and nuclear steel making and presents the design considerations for the high-temperature heat exchanger equipment.

NUCLEAR REACTOR TECHNOLOGY

THEORY AND CALCULATION

REFER ALSO TO CITATION(S) 38130

38154 (LA—8530-PR) **Transport and reactor theory. Progress report, April 1-June 30, 1980.** Dudziak, D.J.; O'Dell, R.D.; Alcouffe, R.E. (Los Alamos Scientific Lab., NM (USA)). Sep 1980. Contract W-7405-ENG-36. 58p. NTIS, PC A04/MF A01.

Progress is summarized in the areas of fission reactor transport codes and methods; supporting research and reactor safety; radiation analysis and fusion reactor nucleonics.

COMPONENTS AND ACCESSORIES

38155 (UCB/EERC—80/06) **Design of steel energy-absorbing restrainers and their incorporation into nuclear power plants for enhanced safety. Volume 1A. Piping with energy-absorbing restrainers: parameter study on small systems.** Powell, G.H.; Oughourlian C.; Simons, J. (California Univ., Berkeley (USA). Earthquake Engineering Research Center). Jun 1980. Contract AT03-76ER70296. 60p. NTIS, PC A04/MF A01.

This report presents results of an analytical parameter study of small piping systems with energy-absorbing restrainers subjected to seismic loading. The investigation extends a previously reported parameter study. Two small piping configurations have been investigated in detail, for a variety of restrainer locations, restrainer strengths and seismic excitations. A larger system has been analyzed for one set of parameters only. Studies of the following were carried out: (1) effect of restrainer strength; (2) effect of restrainer location; (3) sensitivity to small changes in restrainer location; (4) effect of viscous damping; (5) effect of out-of-phase support motions; and (6) effect of restrainer preload due to thermal expansion of piping.

38156 (UCB/EERC—80/20) **Design of steel energy absorbing restrainers and their incorporation into nuclear power plants for enhanced safety. Volume 1C. Numerical method for dynamic substructure analysis.** Dickens, J.M.; Wilson, E.L. (Earthquake Engineering Research Inst., Berkeley, CA (USA)). Jun 1980. Contract AT03-76ER70296. 208p. NTIS, PC A10/MF A01.

This report presents several new or improved numerical methods for the dynamic response analysis of large complex structural systems. The methods presented are primarily concerned with linear dynamic analysis. However, one of the significant results of the research is the development of efficient numerical methods for large systems with a small number of non-linear members. The technique of dynamic substructure analysis is used to accurately model the behavior of the linear part of the system. This approach allows the behavior of the linear structural members to be reduced to a small number of generalized dynamic coordinates. Those linear dynamic coordinates are then used in direct combination with the nonlinear members to approximate the solution of the large nonlinear problem. The methods presented can be applied to structures of arbitrary geometry. However, the use of techniques such as cyclic symmetry can further decrease the numerical effort.

38157 (UCB/EERC—80/21) **Development and testing of restraints for nuclear piping systems.** Kelly, J.M.; Skinner, M.S. (California Univ., Berkeley (USA). Coll. of Engineering). Jun 1980. Contract AT03-76ER70296. 78p. NTIS, PC A05/MF A01.

As an alternative to current practice of pipe restraint within nuclear power plants it has been proposed to adopt restraints capable of dissipating energy in the piping system. The specific mode of energy dissipation focused upon in these studies is the plastic yielding of steels utilizing relative movement between the pipe and the base of the restraint, a general mechanism which has been proven as reliable in several allied studies. This report discusses the testing of examples of two energy-absorbing devices, the results of this testing and the conclusions drawn. This study concentrated on the specific relevant performance characteristics of hysteretic behavior and degradation with use. The testing consisted of repetitive continuous loadings well into the plastic ranges of the devices in a sinusoidal or random displacement controlled mode.

FUEL ELEMENTS

REFER ALSO TO CITATION(S) 37753, 38378

CONTROL SYSTEMS

38158 (CONF-801107—2) **Improved usage of the LOFT process computer.** Bray, M.A. (EG and G Idaho, Inc., Idaho Falls (USA)). 1980. Contract AC07-76ID01570. 5p. NTIS, PC A02/MF A01.

From ANS international conference; Washington, DC, USA (17 Nov 1980).

This paper describes work recently done to upgrade usage of the plant process computer at the Loss-of-Fluid Test (LOFT) facility. The use of computers to aid reactor operators in understanding plant status and diagnosing plant difficulties is currently being widely studied by the nuclear industry. In this regard, an effort was initiated to improve LOFT process computer usage, since the existing plant process computer has been an available, but only lightly used resource, for aiding LOFT reactor operators. This is a continuing effort and has, to date, produced improvements in data collection, data display for operators, and methods of computer operation.

38159 (GA-A—15623) **Operational, control and protective system transient analyses of the closed-cycle GT-HTGR power plant.** Openshaw, F.L.; Chan, T.W. (General Atomic Co., San Diego, CA (USA)). Jul 1980. Contract AT03-76SF70046. 14p. (CONF-801102—27). NTIS, PC A02/MF A01.

From ASME winter annual meeting; Chicago, IL, USA (16 Nov 1980).

This paper presents a description of the analyses of the control/protective system preliminary designs for the gas turbine high-temperature gas-cooled reactor (GT-HTGR) power plant. The control system is designed to regulate reactor power, control electric load and turbine speed, control the temperature of the helium delivered to the turbines, and control thermal transients experienced by the system components. In addition, it provides the required control programming for startup, shutdown, load ramp, and other expected operations. The control system also handles conditions imposed on the system during upset and emergency conditions such as loop trip, reactor trip, or electrical load rejection.

38160 (GA-A—15862) **HTGR-GT and electrical load integrated control.** Chan, T.; Openshaw, F.; Pfremmer, D. (General Atomic Co., San Diego, CA (USA)). May 1980. Contract AT03-76SF70046. 45p. (CONF-801102—22). NTIS, PC A03/MF A01.

From ASME winter annual meeting; Chicago, IL, USA (16 Nov 1980).

A discussion of the control and operation of the HTGR-GT power plant is presented in terms of its closely coupled electrical load and core cooling functions. The system and its controls are briefly described and comparisons are made with more conventional plants. The results of analyses of selected transients are presented to illustrate the operation and control of the HTGR-GT. The events presented were specifically chosen to show the controllability of the plant and to highlight some of the unique characteristics inherent in this multiloop closed-cycle plant.

ENVIRONMENTAL ASPECTS

38161 **Fish entrapment of the seawater intake of a power plant at Karachi coast.** Moazzam, M.; Niaz Risvi, S.H. (Institute of Marine Biology, University of Karachi, Karachi, Pakistan). *Environ. Biol. Fishes;* **5**: No. 1, 49-57(30 Jan 1980).

The study deals with the entrapment of fishes in the intake of Karachi Nuclear Power Plant. A total of 62 species of marine fishes belonging to 43 genera were observed entrapped in the seawater intake. Therapon puta, Liza waigiensis, Abudefduf septemfasciatus, and Lagoceptalus inermis were the most common. Mass mortalities of the juveniles of Sardinella sindensis were recorded in September and October of 1974, 1975, and 1977. Commercially important fishes such as sardines, mullets and anchovies, were entrapped in the intake of the power plant in considerable numbers at various times of the year. The majority of fishes removed from the screen washes of the power plants were killed by impingement.

SITING

38162 (UCRL-Trans—11607) **Methodology for the analysis of environmental parameters on a nationwide scale.** Boeri, G.; Caracciolo, R.; Fiorenza, R.; Giordano, A. (Comitato Nazionale per

l'Energia Nucleare, Rome (Italy)). Jul 1980. Translation of CNEN-RT/PROT—(77)-16, June 1977. 42p. NTIS, PC A03/MF A01.

The methodology set forth in the present report was developed for the analysis of environmental parameters on a nationwide scale. Some examples are presented of the progressive levels of refinement with which the methodology can operate for final territorial analyses to map out suitable sites for nuclear plants. Obviously the decision process concerning territorial choices to be made is very complicated and entails the integration of a large number of parameters - including those of a nontechnical nature. For these reasons CNEN, while preparing to present and discuss with ENEL and the Regions the systematic criteria for choosing optimum nuclear sites on the regional and national scale, has developed a first level of visualization for the relevant territorial parameters in accord with the methods described.

RADIOACTIVE EFFLUENTS

REFER ALSO TO CITATION(S) 38708

38163 **Assessment of environmental radiation hazards from the Koeberg nuclear power station.** Basson, J.K. (Atomic Energy Board, Pelindaba, Pretoria (South Africa). Isotopes and Radiation Div.); Winkler, B.C. (Atomic Energy Board, Pelindaba, Pretoria (South Africa). Licensing Branch); Walmsley, J. (Electricity Supply Commission, Johannesburg (South Africa)). *Civ. Eng. S. Afr.;* **22**: No. 4, 91-95(Apr 1980).

Escom's decision to build the 2 x 922 MW (e) Koeberg nuclear power station on the coastal Duynefontein site, 28 km north of Cape Town is explained. After describing the internationally accepted basis of radiation protection, the philosophy of nuclear-installation licensing, as applied by the AEB Licensing Branch, is outlined. Preoperational environmental investigations that have provided acceptable release rates of radioactive effluent to the sea and the atmosphere are discussed. Accidental releases are described and the sound basis of such studies is compared with normal industrial undertakings.

38164 (UCID—18783) **Preliminary comparisons between measurements and model calculations for the TMI venting of ^{85}Kr.** Dickerson, M.H. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). Aug 1980. Contract W-7405-ENG-48. 21p. NTIS, PC A02/MF A01.

ARAC was on-line calculating hourly concentration values during the TMI-2 venting of ^{85}Kr gas from June 28 to July 11, 1980. During this time hourly isopleths of normalized instantaneous concentration were calculated and transmitted to EPA in Middletown, PA. These isopleths were used to help locate the EPA and Penn State mobile air samplers and they were used for comparison to the EPA fixed 24 hr sampler measurements and the DOE helicopter measurements. This report summarizes preliminary comparisons for the EPA fixed samplers and the DOE helicopters.

38165 (UCRL-Trans—11608) **Calculation model for evaluation of doses due to effluents from the operation of nuclear installations.** Boeri, G.C.; Brofferio, C.; Caracciolo, R.; Fiorenza, R. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Jul 1980. Translation source information not available . 10p. NTIS, PC A02/MF A01.

A summarizing description is given for a compartment model for the evaluation, under equilibrium conditions, of the effects of operating effluents from nuclear installations. On the basis of this model two calculation codes were developed (DEAR and DELIR) for gaseous and liquid effluents. The methods of use of these codes are described along with possible processing methods. To perform an evaluation of the environmental impact of effluents from nuclear power plants, a mathematical model was developed. This model, based on the interaction between compartments, in particular expresses predictions under equilibrium conditions. The numerical processing is then handed over to two codes written in Fortran IV, DEAR and DELIR, for gaseous and liquid effluents, respectively.

CHEMICAL AND THERMAL EFFLUENTS

REFER ALSO TO CITATION(S) 38844

RESEARCH, TEST, AND EXPERIMENTAL REACTORS

REFER ALSO TO CITATION(S) 38158, 38182, 38185, 38186, 38190, 38192, 38626

38166 (CONF-801107—1) **Response of LOFT SPNDs to reactor coolant density variations during a LOCA simulation.** Adams, J.P.; Berta, V.T. (EG and G Idaho, Inc., Idaho Falls (USA)). 1980. Contract AC07-76ID01570. 6p. NTIS, PC A02/MF A01.

From ANS international conference; Washington, DC, USA (17 Nov 1980).

Analysis of self-powered neutron detector (SPND) data taken during loss-of-coolant experiment (LOCE) L2-3 conducted in the Loss-of-Fluid Test (LOFT) facility has shown that the detectors are sensitive, in a qualitative sense, to coolant density variations in the reactor core. These results provide a strong impetus for determining the applicability of self-powered nuclear flux detectors fo$_{\text{a}}$ liquid level measurement in the reactor vessel of a pressurized water reactor (PWR) during transient conditions. This summary discusses the response of the LOFT SPNDs to core coolant density variations in the L2-3 large break experiment and shows the potential application to reactor vessel liquid level measurements during small break accidents in PWRs.

38167 (CONF-801107—3) **Measurement of stochastic flow-induced power fluctuations at LOFT.** Cannon, J.W.; Clemo, T.M. (Idaho National Engineering Lab., Idaho Falls (USA)). 1980. Contract AC07-76ID01570. 6p. NTIS, PC A02/MF A01.

From ANS international conference; Washington, DC, USA (17 Nov 1980).

Investigation of power fluctuations at LOFT began after peak to peak power fluctuations of 1.5% of full power were observed prior to Loss of Coolant Experiment L2-3. The power fluctuations are caused by fluctuations in primary coolant flow. The fluctuations in coolant flow result in fluctuations in moderator temperature, which through the moderator coefficient of reactivity, cause the power fluctuations. This conclusion is supported experimentally by the high coherence between power and flow, and by the increase in power fluctuation magnitude with steady-state power and with increasing temperature coefficient. A theoretical model of the phenomenon is being developed to determine the power fluctuations' dependence on moderator and doppler coefficient, and predict fluctuation behavior during future operation.

38168 (CONF-801107—4) **Sensitivity and a priori uncertainty analysis of the CFRMF central flux spectrum.** Ryskamp, J.M.; Anderl, R.A.; Broadhead, B.L.; Ford, W.E. III; Lucius, J.L.; Marable, J.H. (EG and G Idaho, Inc., Idaho Falls (USA)). 1980. Contract AC07-76ID01570. 7p. NTIS, PC A02/MF A01.

From ANS international conference; Washington, DC, USA (17 Nov 1980).

The Coupled Fast Reactivity Measurements Facility (CFRMF), located at the Idaho National Engineering Laboratory, is a zoned-core critical assembly with a fast-neutron-spectrum zone in the center of an enriched ^{235}U, water-moderated thermal driver. An accurate knowledge of the central neutron spectrum is important to data-testing analyses which utilize integral reaction-rate data measured for samples placed in the CFRMF field. The purpose of this paper is to present the results of a study made with the AMPX-II and FORSS code systems to deterine the central-spectrum flux covariance matrix due to uncertainties and correlations in the nuclear data for the materials which comprise the facility.

38169 (CONF-801107—21) **Non-uniform tagging and flow structure effects in PNA measurements.** Perez-Griffo, M.L.; Block, R.C.; Lahey, R.T. Jr. (Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Nuclear Engineering). 1980. Contract AC07-76ID01570. 8p. NTIS, PC A02/MF A01.

From ANS international conference; Washington, DC, USA (17 Nov 1980).

The Pulsed Neutron Activation (PNA) technique provides a method for measuring flow properties without perturbing the flowing fluids. This work discusses two of the difficulties encountered in the use of this technique: the effect of flow structure on the interpretation of PNA experiments and the effect of non-uniform tagging in large diameter pipes.

38170 (EGG—2059) **Decontamination and decommissioning of the Organic Moderated Reactor Experiment facility (OMRE).** Hine, R.E. (Idaho National Engineering Lab., Idaho Falls (USA)). Sep 1980. Contract AC07-76ID01570. 98p. NTIS, PC A05/MF A01.

This report describes the decontamination and decommissioning (D and D) of the Organic Moderated Reactor Experiment (OMRE) facility performed from October 1977 through September 1979. This D and D project included removal of all the facilities and as much contaminated soil and rock as practical. Removal of the reactor pressure vessel was an unusually difficult problem, and an extraordinary, unexpected amount of activated rock and soil was removed. After removal of all significantly contaminated material, the site consisted of a 20-ft deep excavation surrounded by backfill material. Before this excavation was backfilled, it and the backfill material were radiologically surveyed and detailed records made of these surveys. After the excavation was backfilled and graded, the site surface was surveyed again and found to be essentially uncontaminated.

38171 (EGG-PHYS—5243) **Sensitivity and a priori uncertainty analysis of the CFRMF central flux spectrum.** Ryskamp, J.M.; Anderl, R.A.; Broadhead, B.L.; Ford, W.E. III; Lucius, J.L.; Mara-

ble, J.H.; Wagschal, J.J. (EG and G Idaho, Inc., Idaho Falls (USA)). Sep 1980. Contract AC07-76ID01570. 48p. NTIS, PC A03/MF A01.

The Coupled Fast Reactor Measurement Facility (CFRMF), is a zoned-core critical assembly with a fast-neutron-spectrum zone in the center of an enriched U-235, water-moderated thermal driver. The central neutron spectrum is a Cross-Section Evaluation Working Group (CSEWG) benchmark field for data testing of fission-product, actinide, and dosimetry cross sections important to fast reactor technology. The AMPX and FORSS code systems were used to determine a flux covariance matrix for the CFRMF central neutron spectrum due to neutral cross-section and fission-spectrum uncertainties and correlations. Uncertainties in the ^{238}U inelastic-scattering cross sections and ^{235}U fission spectrum contribute most to the standard deviations in the central flux spectrum. The full flux-spectrum covariance matrix contains strong correlations. This strongly motivates including the off-diagonal elements in data-testing and cross-section adjustment application.

38172 (GEFR-SP—00445) **Some observations in the analysis of heterogeneous core critical experiments and their implications to reactor design.** Lu, Y.S.; Stewart, S.L. (General Electric Co., Sunnyvale, CA (USA)). 12 Sep 1980. Contract AT03-76-SF71031. 17p. (CONF-800942—7). NTIS, PC A02/MF A01.

From ANS topical meeting on 1980 advances in reactor physics and shielding; Sun Valley, ID, USA (14 Sep 1980).

Analysis of heterogeneous core critical experiments was carried out at GE-ARSD and the results from the analysis provided a basis to: (1) assess the adequacy of the current design methodology; (2) verify the consistency of the basic nuclear data; and (3) address the important observations that may lead to the characterization of the neutronic behavior of a heterogeneous design. The critical experiments were performed in the Zero Power Plutonium Reactor (ZPPR) by Argonne National Laboratory and the assemblies were identified as ZPPR-7 and ZPPR-8. The analysis of the eigenvalue and reaction rate measurements in these heterogeneous critical assemblies is of primary interest and provides valuable information in application of integral measurements to reactor design. The purpose of this paper is to present: (1) some selected analysis results and important observations; (2) cross section sensitivity study results and possible correlations; and (3) implications of the analysis results to reactor design.

38173 (HEDL-SA—1991-FP) **Design considerations for mechanical snubbers.** Severud, L.K.; Summers, G.D. (Hanford Engineering Development Lab., Richland, WA (USA)). Mar 1980. Contract AC14-76FF02170. 16p. (CONF-800804—30). NTIS, PC A02/MF A01.

From ASME century 2 emerging technology conference; San Francisco, CA, USA (10 Aug 1980).

The use of mechanical snubbers to restrain piping during an earthquake event is becoming more common in design of nuclear power plants. The design considerations and qualification procedures for mechanical snubbers used on the Fast Flux Test Facility will be presented. Design precautions and requirements for both normal operation and seismic operation are necessary. Effects of environmental vibration (nonseismic) induced through the piping by pump shaft imbalance and fluid flow oscillations will be addressed. Also, the snubber dynamic characteristics of interest to design and snubber design application considerations will be discussed.

38174 (HEDL-SA—1994-FP) **Seismic analysis of piping with nonlinear supports.** Barta, D.A.; Huang, S.N.; Severud, L.K. (Hanford Engineering Development Lab., Richland, WA (USA)). Jan 1980. Contract AC14-76FF02170. 23p. (CONF-800804—28). NTIS, PC A02/MF A01.

From ASME century 2 emerging technology conference; San Francisco, CA, USA (10 Aug 1980).

The modeling and results of nonlinear time-history seismic analyses for three sizes of pipelines restrained by mechanical snubbes are presented. Numerous parametric analyses were conducted to obtain sensitivity information which identifies relative importance of the model and analysis ingredients. Special considerations for modeling the pipe clamps and the mechanical snubbers based on experimental characterization data are discussed. Comparisions are also given of seismic responses, loads and pipe stresses predicted by standard response spectra methods and the nonlinear time-history methods.

38175 (RHO-CD—864) **Functional design criteria for EBR-II - spent fuel cask.** Moose, J.M. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Mar 1980. Contract AC-06-77RL01030. 9p. NTIS, PC A02/MF A01.

Irradiated Uranium, Plutonium mixed oxide experimental fuel pins from EBR-II have been examined in Hanford Engineering Development Laboratories (HEDL) hot cells and steadily accumulated to the extent that the storage capacity at HEDL is saturated. A large quantity of excess fuel must be transferred from the hot cells for storing at the 200 Area to accommodate handling discharged pins from the Fast Flux Test Facility (FFTF). The spent fuel will be consolidated in six (6) HEDL Spent Fuel Packages. The HEDL Packages are 5.625 in diameter x 41 inches in length and are composed of 28 inner tubes packaged in two welded outer containers.

38176 (UCRL—15275) **Inspection methods for physical protection Task III review of other agencies' physical security activities for research reactors.** (Teknekron Research, Inc., Berkeley, CA (USA). Energy and Environmental Systems Div.). [nd]. Contract W-7405-ENG-48. 29p. NTIS, PC A03/MF A01.

In Task I of this project, the current Nuclear Regulatory Commission (NRC) position-on physical security practices and procedures at research reactors were reviewed. In the second task, a sampling of the physical security plans was presented and the three actual reactor sites described in the security plans were visited. The purpose of Task III is to review other agencies' physical security activities for research reactors. During this phase, the actions, procedures and policies of two domestic and two foreign agencies other than the NRC that relate to the research reactor community were examined. The agencies examined were: International Atomic Energy Agency; Canadian Atomic Energy Control Board; Department of Energy; and American Nuclear Insurers.

PLUTONIUM AND ISOTOPE PRODUCTION REACTORS

38177 (CONF-800814—22(Draft)) **Production of transplutonium elements in the high flux isotope reactor (HFIR).** Bigelow, J.E.; Corbett, B.L.; King, L.J.; McGuire, S.C.; Sims, T.M. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 32p. NTIS, PC A03/MF A01.

From 180. American Chemical Society meeting/2. chemical congress of the North American Continent; San Francisco, CA, USA (24 Aug 1980).

The techniques described have been demonstrated to be adequate to predict the contents of transplutonium element production targets which have been irradiated in the HFIR. The deviations, at least for isotopes of mass 253 or less, are generally within the usual analytical uncertainties, or else are for isiotopes which are of little overall import to the program. Work is especially needed to get a better picture of the production of ^{250}Cm, ^{254}Es, ^{255}Es, and ultimately ^{257}Fm, since researchers are frequently stating their interest in obtaining larger quantities of these rare and difficult-to-produce nuclides.

38178 (DP-MS—80-100) **Automatic diagnosis of alarms: a system to improve operator emergency response.** Olson, H.P.; Gimmy, K.L.; Nomm, E.; Finley, R.H. (Du Pont de Nemours (E.I) and Co., Aiken, SC (USA). Savannah River Lab.). 1980. Contract AC09-76SR00001. 17p. (CONF-801056—1). NTIS, PC A02/MF A01.

From International conference on current nuclear power plant safety issues; Stockholm, Sweden (26 Oct 1980).

A system is being developed at the Savannah River Plant to help reactor operators respond to multiple alarms in a developing incident situation. The need for such systems has becme evident in recent years, particularly after the Three Mile Island incident.

38179 (UNI-SA—78) **Flux wire as an incore remote surveillance tool.** Toffer, H.; Richardson, R.L.; Clayhold, J.A. (UNC Nuclear Industries, Inc., Richland, WA (USA)). 2 Jul 1980. Contract AC06-76RL01857. 9p. (CONF-801107—5). NTIS, PC A02/MF A01.

From ANS international conference; Washington, DC, USA (17 Nov 1980).

A reactor core is one of the most hostile environments for direct surveillance and monitoring, especially during full power operation. Indirect methods have to be used to infer changes in core configurations. The use of flux wires as a viable means for incore surveillance has been successfully demonstrated at the Hanford N Reactor. Core component locations and changes in core configuration have been identified with properly evaluated flux wire activation traces. A Traveling Wire Flux Mapping (TWFM) system has been used at the N Reactor to determine axial power peaking factors for over 15 years. The system consists of nine penetrations through the core, parallel to the fuel charges, into which flexible helical wound carbon steel cable approximately 0.44 cm. in diameter can be inserted. Following a 20-minute irradiation, the wires are withdrawn and counted. The activity of Mn-56 (2.86 hour half-life) is recorded. Spacial resolution along the length of the wire is better than 2.5 cm.

REACTOR SAFETY

REFER ALSO TO CITATION(S) 37701, 38154, 38164, 38842

38180 (BNL-NUREG—26903) **PWR steamline break analysis assuming concurrent steam generator tube rupture.** Shier, W.G.;

Levine, M.M. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 18p. (CONF-801002—9). NTIS, PC A02/MF A01.

From ANS/ASME topical meeting on reactor thermal-hydraulics; Saratoga, NY, USA (9 Oct 1980).

Results are presented for a steamline break analysis for a typical, two-loop, 2560 MW(t) pressurized water reactor. The calculations were performed using the IRT reactor system transient analysis code. Included are the analyses of steamline break transients assuming concurrent steam generator tube rupture (up to 30 steam generator tubes). Graphical and tabular results are presented.

38181 (CONF-800607—87(Draft)) **Fission product release from high gap-inventory LWR fuel under LOCA conditions.** Lorenz, R.A.; Collins, J.L.; Osborne, M.F.; Malinauskas, A.P. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 7p. NTIS, PC A02/MF A01.

From American Nuclear Society annual meeting; Las Vegas, NV, USA (8 Jun 1980).

Fission product release tests were performed with light water reactor (LWR) fuel rod segments containing large amounts of cesium and iodine in the pellet-to-cladding gap space in order to check the validity of the previously published Source Term Model for this type of fuel. The model describes the release of fission product cesium and iodine from LWR fuel rods for controlled loss-of-coolant accident (LOCA) transients in the temperature range 500 to 1200°C. The basis for the model was test data obtained with simulated fuel rods and commercial fuel irradiated to high burnup but containing relatively small amounts of cesium and iodine in the pellet-to-cladding gap space.

38182 (CONF-800942—9) **LOFT: a nuclear plant providing realistic answers to PWR licensing issues.** Solbrig, C.W.; Linebarger, J.H.; Kaufman, N.C. (EG and G Idaho, Inc., Idaho Falls (USA)). 1980. Contract AC07-76ID01570. 15p. NTIS, PC A02/MF A01.

From ANS topical meeting on 1980 advances in reactor physics and shielding; Sun Valley, ID, USA (14 Sep 1980).

This paper discusses the role the Loss-of-Fluid Test (LOFT) Experimental Program has played and will play in addressing licensing issues of interest to the US Nuclear Regulatory Commission (NRC), nuclear steam supply system vendors, and utility power companies. The LOFT facility is an operating, prototypically scaled pressurized water reactor (PWR) system in which experiments are performed that characterize conditions for postulated accidents in a commercial PWR. The accident conditions imposed have not caused damage to the LOFT system, and the system has been succesfully stabilized and recovered in each instance. Data from these experiments have provided and will continue to provide realistic answers to PWR licensing issues both before and after the accident at Three Mile Island (TMI).

38183 (CONF-800942—14) **Systematic methodology for the reduction of uncertainties in transient thermal-hydraulics by using in-bundle measurement data.** Barhen, J.; Cacuci, D.G.; Wagschal, J.J.; Mullins, C.B. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 13p. NTIS, PC A02/MF A01.

From ANS topical meeting on 1980 advances in reactor physics and shielding; Sun Valley, ID, USA (14 Sep 1980).

The development of a systematic methodology for the reduction of uncertainties in transient thermal-hydraulics by using in-bundle measurement data is presented. The adjustment of the system parameters and responses and the reduction in their respective uncertainties is treated as a time-dependent constrained minimization problem. An on-line (i.e., real time) large scale optimization scheme is also outlined. Although formulated within the framework of reactor safety analysis, the proposed methodology can be directly applied to other areas, for instance to time-dependent fuel cycle optimization and uncertainty analysis.

38184 (CONF-800971—1) **Assessment of light water reactor fuel damage during a reactivity initiated accident.** MacDonald, P.E.; Seiffert, S.L.; Martinson, Z.R.; McCardell, R.K.; Owen, D.E.; Fukuda, S.K. (Idaho National Engineering Lab., Idaho Falls (USA)). 1980. Contract AC07-76ID01570. 60p. NTIS, PC A04/MF A01.

From CNSI specialist meeting on safety aspects of fuel behavior in off-normal and accident conditions; Helsinki, Finland (1 Sep 1980).

This paper presents an assessment of LWR fuel damage during a reactivity initiated accident and comments on the adequacy of the present USNRC design requirements. Results from early SPERT tests are reviewed and compared with results from recent computer simulations and PBF tests. A progression of fuel rod and cladding damage events is presented. High strain rate deformation of relatively cool irradiated cladding early in the transient may result in fracture at a radial average peak fuel enthalpy of approximately 140 cal/g UO_2. Volume expansion of previously irradiated fuel upon melting may cause deformation and rupture of the cladding, and coolant channel blockage at higher peak enthalpies.

38185 (CONF-800971—2) **Safety and licensing issues that are being addressed by the Power Burst Facility test programs.** McCardell, R.K.; MacDonald, P.E. (Idaho National Engineering Lab., Idaho Falls (USA)). 1980. Contract AC07-76ID01570. 32p. NTIS, PC A03/MF A01.

From CNSI specialist meeting on safety aspects of fuel behavior in off-normal and accident conditions; Helsinki, Finland (1 Sep 1980).

This paper presents an overview of the results of the experimental program being conducted in the Power Burst Facility and the relationship of these results to certain safety and licensing issues. The safety issues that were addressed by the Power-Cooling-Mismatch, Reactivity Initiated Accident, and Loss of Coolant Accident tests, which comprised the original test program in the Power Burst Facility, are discussed. The resolution of these safety issues based on the results of the thirty-six tests performed to date, is presented. The future resolution of safety issues identified in the new Power Burst Facility test program which consists of tests which simulate BWR and PWR operational transients, anticipated transients without scram, and severe fuel damage accidents, is described.

38186 (CONF-801102—1) **Results and predictions of scaled, nuclear large break loss-of-coolant experiments.** Grush, W.H.; Lin, J.C.; Linebarger, J.H.; Nelson, R.A. Jr. (EG and G Idaho, Inc., Idaho Falls (USA)). 1980. Contract AC07-76ID01570. 26p. NTIS, PC A03/MF A01.

From ASME winter annual meeting; Chicago, IL, USA (16 Nov 1980).

Two 200% cold leg break loss-of-coolant experiments performed in the LOFT facility have exhibited early core-wide quenches which were not predicted by the RELAP4/MOD6 code. Posttest studies have shown that while the critical flow model used significantly affects the hydraulic calculation, the principal reason for not predicting the quench behavior lies in the area of post-CHF heat transfer. The ability of the code to calculate quenches using a modified heat transfer surface is demonstrated, thereby emphasizing the need for better understanding of post-CHF heat transfer processes.

38187 (CONF-801102—4) **Post CHF heat transfer and quenching.** Nelson, R.A.; Condie, K.G. (EG and G Idaho, Inc., Idaho Falls (USA)). 1980. Contract AC07-76ID01570. 14p. NTIS, PC A02/MF A01.

From ASME winter annual meeting; Chicago, IL, USA (16 Nov 1980).

This paper describes quantitatively new mechanisms in the post-CHF regime which provide understanding and predictive capability for several current two-phase forced convective heat transfer problems. These mechanisms are important in predicting rod temperature turnaround and quenching during the reflood phase of either a hypothetical loss-of-coolant accident (LOCA) or the FLECHT and Semiscale experiments. The mechanisms are also important to the blowdown phase of a LOCA or the recent Loss-of-Fluid Test (LOFT) experiments L2-2 and L2-3, which were 200% cold leg break transients. These LOFT experiments experienced total core quenching in the early part of the blowdown phase at high (1000 psia) pressures. The mechanisms are also important to certain pressurized water reactor (PWR) operational transients where the reactor may operate in the post-CHF regime for short periods of time. Accurate prediction of the post-CHF heat transfer including core quench during these transients is of prime importance to limit maximum cladding temperatures and prevent cladding deformation.

38188 (CONF-801102—6) **Investigation of small break loss-of-coolant phenomena in a small scale nonnuclear test facility.** Cozzuol, J.M.; Fauble, T.J.; Harvego, E.A. (Idaho National Engineering Lab., Idaho Falls (USA)). 1980. Contract AC07-76ID01570. 13p. NTIS, PC A02/MF A01.

From ASME winter annual meeting; Chicago, IL, USA (16 Nov 1980).

A small-scale nonnuclear integral test facility designed to simulate a pressurized water reactor (PWR) system was used to evaluate the effects of a small break loss-of-coolant accident (LOCA) on the system thermal-hydraulic response. The experiment approximated a 2.5% (11-cm diameter) communicative break in the cold leg of a PWR, and included initial conditions which were similar to conditions in a PWR operating at full power. The 2.5% break size ensured that the nominal break flow rate was greater than the high pressure injection system (HPIS) flow rate, thus providing the potential for a continuous system depressurization. The sequence of events was similar to that used in evaluation model analysis of small break loss-of-coolant accidents, and included simulated reactor scram and loss of offsite power. Comparisions of experimental data with computer code calculations are used to demonstrate the capabilities and limitations of integral system calculations used to predict phenomena which can be important in the assessment of a small break LOCA in a PWR.

38189 (CONF-801102—7) **Forced convective post CHF heat transfer and quenching.** Nelson, R.A. (EG and G Idaho, Inc., Idaho Falls (USA)). 1980. Contract AC07-76ID01570. 35p. NTIS, PC A03/MF A01.

From ASME winter annual meeting; Chicago, IL, USA (16 Nov 1980).

This paper discusses mechanisms in the post-CHF region which provide understanding and qualitative prediction capability for several current forced convective heat transfer problems. In the area of nuclear reactor safety, the mechanisms are important in the prediction of fuel rod quenches for the reflood phase, blowdown phase, and possibly some operational transients with dryout. Results using the mechanisms to investigate forced convective quenching are presented. Data reduction of quenching experiments is discussed, and the way in which the quenching transient may affect the results of different types of quenching experiments is investigated. This investigation provides an explanation of how minimum wall superheats greater than the homogeneous nucleation temperature result, as well as how these may appear to be either hydrodynamically or thermodynamically controlled. Finally, the results of a parametric study of the effects of the mechanisms upon the LOFT L2-3 hotpin calculation are presented.

38190 (CONF-801102—11) **Test PCM-5 rod bowing and bow direction reversal.** Kerwin, D.K. (Idaho National Engineering Lab., Idaho Falls (USA)). 1980. Contract AC07-76ID01570. 3p. NTIS, PC A02/MF A01.

From ASME winter annual meeting; Chicago, IL, USA (16 Nov 1980).

Test PCM-5 was the first bundle test in the PCM Test Series being conducted by the Thermal Fuels Behavior Program of EG and G Idaho, Inc. as part of the Nuclear Regulatory Commission's Fuel Behavior Program. The experiment was performed in the Power Burst Facility (PBF) reactor at the Idaho National Engineering Laboratory. The bundle consisted of nine previously unirradiated PWR-type fuel rods, arranged in a 3 x 3 array within a square cross section flow shroud, with rod-to-rod spacing typical of a commercial 15 x 15 PWR bundle. The objectives of the test were to operate the bundle in high temperature (> 1250 K) film boiling with the center rod in an environment typical of a commercial reactor rod subjected to a PCM transient, and to investigate the potential for rod-to-rod interactions. Film boiling was initiated by slowly increasing reactor power while maintaining an approximately constant coolant flow rate (~ 1150 kg/m^2.s). Rod peak powers ranged from 55 to 62 kW/m.

38191 (DOE/TIC—11262) **Development of film thickness and velocity probes for use in simulated reactor LOCA experiments.** Hess, R.A.; Remenyik, C.J. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 30p. NTIS, PC A03/MF A01.

During the reflood phase of a loss of coolant accident (LOCA), a significant portion of the liquid inventory will exist in the form of thin films on interior surfaces of the vessel. A class of impedance probes known as film probes have been developed to measure the thickness and velocity of condensate films in high temperature steam-water systems. Film thickness is measured by two flush mounted electrodes on the surface walls. Film velocities are measured by utilizing the effect of the film velocity upon the charge transfer impedance between the electrode surface and the liquid whenever a D.C. potential is applied to the electrodes.

38192 (EGG/LTR-LO—87-138) **LOFT lead rod test results evaluation.** Driskell, W.B.; Tolman, E.L. (EG and G Idaho, Inc., Idaho Falls (USA)). 30 Jul 1980. Contract AC07-76ID01570. 74p. NTIS, PC A04/MF A01.

The purpose for evaluating the LOFT Lead Rod Test (simulations of large break, loss-of-coolant accidents) data was to determine; (a) if the centerline thermocouple and fuel rod elongation sensor data show indications of the collapsed fuel rod cladding, (b) the capability of the FRAP-T5 computer code to accurately predict cladding collapse, and (c) if cladding surface thermocouples enhance fuel rod cooling. With consideration to unresolved questions on data integrity, it was concluded that: the fuel rod centerline thermocouple and elongation sensor data do show indications of the fuel rod cladding collapse; the FRAP-T5 code conservatively predicts cladding collapse; and there is an indication that cladding surface thermocouples are enhancing fuel rod cooling.

38193 (GA-A—15994) **Personnel radiation exposure in HTGR plants.** Su, S.; Engholm, B.A. (General Atomic Co., San Diego, CA (USA)). 1980. Contract AT03-76ET35300. 15p. (CONF-800946—1). NTIS, PC A02/MF A01.

From IAEA specialists meeting on gas cooled reactor safety and licensing aspects; Lausanne, Switzerland (1 Sep 1980).

Occupational radiation exposures in high-temperature gas-cooled reactor (HTGR) plants were assessed. The expected rate of dose accumulations for a large HTGR steam cycle (HTGR-SC) unit is 0.07 man-rem/MW(e)y, while the design basis is 0.17 man-rem/MW(e)y. The comparable figure for actual light water reactor (LWR) experience is 1.3 man-rem/MW(e)y. The favorable HTGR occupational exposure is supported by results from the Peach Bottom Unit No. 1 HTGR and Fort St. Vrain HTGR plants and by operating experience at British gas-cooled reactor (GCR) stations.

38194 (LA-UR—80-1844) **De-entrainment on vertical elements in air droplet cross flow.** Dallman, J.C.; Kirchner, W.L. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 10p. (CONF-801102—18). NTIS, PC A02/MF A01.

From ASME winter annual meeting; Chicago, IL, USA (16 Nov 1980).

De-entrainment phenomena on vertical elements in air-water droplet cross flow are generated using a horizontal array of water spray nozzles and a draft-induced wind tunnel. These conditions are used to obtain experimental values of the de-entrainment efficiency of isolated elements (25.4-, 63.5-, and 101.6-mm-diam cylinders and a 76.2-mm-square tube), and of an array of 101.6-mm-diam cylinders. A flow model is developed that extrapolates the de-entrainment efficiency of isolated elements through the use of a correlation for the interference effect to predict the efficiency of large arrays of similar elements. This simple model is shown to provide a good prediction of the de-entrainment efficiency of arrays in terms of the efficiency of an isolated element.

38195 (NP—24200) **Report of the President's Commission on the accident at Three Mile Island. The need for change: the legacy of TMI.** (President's Commission on the Accident at Three Mile Island, Washington, DC (USA)). Oct 1979. 207p. GPO.

Information is presented concerning the findings of the Commission; recommendations of the Commission; supplemental views; and account of the accident.

38196 (NP—25106) **Report of the Office of Chief Counsel on the role of the managing utility and its suppliers.** Gorinson, S.M.; Kane, K.P. (President's Commission on the Accident at Three Mile Island, Washington, DC (USA)). Oct 1979. 239p. GPO.

Information is presented concerning the role of General Public Utilities Service Corp.; site change; role of Met Ed in design of TMI-2; control room design; containment isolation criteria selection; GPUSC startup and test group; commercial operation; management relationships within the utility; site management; review committees; procedures; attention to experience; NRC inspections; management approach to the emergency; and the TMI-2 recovery program.

38197 (ORNL/CSD—53) **SACRD: a data base for fast reactor safety computer codes, operational procedures.** Forsberg, V.M.; Arwood, J.W.; Greene, N.M.; Raiford, G.B. (Oak Ridge National Lab., TN (USA)). Sep 1980. Contract W-7405-ENG-26. 124p. NTIS, PC A06/MF A01.

SACRD (Safety Analysis Computerized Reactor Data) is a data base of nondesign-related information used in computer codes for fast reactor safety analyses. This document reports the procedures used in SACRD to help assure a reasonable level of integrity of the material contained in the data base. It also serves to document much of the computer software used with the data base.

38198 (SAND—80-1535C) **One-dimensional transient model for analyzing large-scale steam explosion experiments.** Corradini, M.L. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 7p. (CONF-801107—12). NTIS, PC A02/MF A01.

From ANS international conference; Washington, DC, USA (17 Nov 1980).

In the unlikely event of a core meltdown accident, an important safety issue is the potential for steam explosions and their effects on the accident progression. Steam explosion phenomena can be divided into three stages: (a) mixing of the molten fuel and water; (b) triggering and spatial propagation of rapid fuel fragmentation through the fuel-coolant mixture; and (c) expansion of the steam against the surroundings. The consequences of such an expansion may be missile generation or static pressurization of the vessel or containment and fuel debris dispersal. This paper describes a recently developed one-dimensional, transient computer model which attempts to describe the triggering, propagation, and expansion of large-scale steam explosions.

38199 (SAND—80-1574) **Light Water Reactor Safety Technology Program. Quarterly report, January—March 1980.** Dahlgren, D.A. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1980. Contract AC04-76DP00789. 68p. NTIS, PC A04/MF A01.

Information is presented concerning the management support progam; risk methods utilization; improved safety systems; man-machine interface; and safety data.

38200 (CONF-801102—12) **Experimental determination of lower plenum ECC injection effectiveness.** Hanson, R.G. (Idaho National Engineering Lab., Idaho Falls (USA)). [nd]. Contract AC07-76ID01570. 25p. NTIS, PC A02/MF A01.

From ASME winter annual meeting; Chicago, IL, USA (16 Nov 1980).

The effectiveness of lower plenum emergency core coolant (ECC) injection during a double ended offset shear cold leg break loss-of-coolant accident (LOCA) was investigated experimentally in a small-scale model of a pressurized water reactor (PWR). In order to determine relative merit of the lower plenum injection concept to mitigate the severity of a large break LOCA, data from lower plenum injection experiments were compared to data from an experiment in the Semiscale Mod-3 sytem in which cold leg ECC injection was utilized. The results indicated that lower plenum injection was extremely effective in initiating early reflooding of the core and earlier rod quenching than was observed in the cold leg injection experiment.

ENERGY STORAGE

MAGNETIC

38201 (LA-UR—80-2589) **Magnetic energy storage.** Rogers, J.D. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 7p. (CONF-800980—5). NTIS, PC A02/MF A01.

From Applied superconductivity conference; Santa Fe, NM, USA (29 Sep 1980).

The fusion program embraces low loss superconductor strand development with integration into cables capable of carrying 50 kA in pulsed mode at high fields. This evolvement has been paralleled with pulsed energy storage coil development and testing from tens of kJ at low fields to a 20 MJ prototype tokamak induction coil at 7.5 T. Energy transfer times have ranged from 0.7 ms to several seconds. Electric utility magnetic storage for prospective application is for diurnal load leveling with massive systems to store 10 GWh at 1.8 K in a dewar structure supported on bedrock underground. An immediate utility application is a 30 MJ system to be used to damp power oscillations on the Bonneville Power Administration electric transmission lines. An off-shoot of this last work is a new program for electric utility VAR control with the potential for use to suppress subsynchronous resonance. This paper presents work in progress, work planned, and recently completed unusual work.

COMPRESSED GAS

38202 (PNL—3431) **Compressed air energy storage (CAES) environmental control concerns and program plan.** Beckwith, M.A.; Boehm, D.W. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1980. Contract AC06-76RL01830. 55p. NTIS, PC A04/MF A01.

This report assesses the required environmental research and recommends a program plan to assist DOD's Environmental Control Technology Division (ECT) in performing its mission of ensuring that the procedures, processes, systems, and strategies necessary to minimize any adverse environmental impacts of compressed air energy storage (CAES) are developed in a timely manner so as not to delay implementation of the technology. To do so, CAES technology and the expected major environmental concerns of the technology are described. Second, ongoing or planned research in related programs and the applicability of results from these programs to CAES environmental research are discussed. Third, the additional research and development required to provide the necessary environmental data base and resolve concerns in CAES are outlined. Finally, a program plan to carry out this research and development effort is presented.

PUMPED HYDRO

38203 (ANL/ES—100) **Evaluation of advanced hydraulic turbomachinery for underground pumped hydroelectric storage. Part 1. Single-stage regulated pump turbines for operating heads of 500 to 1000 m.** Frigo, A.A.; Blomquist, C.A.; Degnan, J.R. (Argonne National Lab., IL (USA)). Oct 1979. Contract W-31-109-ENG-38. 134p. NTIS, PC A07/MF A01.

High-head, large-capacity turbomachinery is needed for the concept of underground pumped hydroelectric storage to be technically and economically attractive. Single-stage, reversible, Francis-type pump turbines with adjustable wicket gates appear to offer the most economically attractive option for heads between about 500 and 1000 m. The feasibility of developing these types of machines for capacities up to 500 MW and operating heads up to 1000 m has been evaluated. Preliminary designs have been generated for six single-stage pump turbines. The designs are for capacities of 350 and 500 MW and for operating heads of 500, 750, and 1000 m. The report contains drawings of the machines along with material specifications and hydraulic performance data. Mechanical, hydraulic, and economic analyses indicate that these machines will behave according to the criteria used to design them and that they can be built at a reasonable cost. The stress and deflection responses of the 500-MW, 100-m-head pump turbine, determined by detailed finite element analysis techniques, give solid evidence of the integrity of the conceptual designs of the six units and indicate no unsolvable problems. Results of a life expectancy analysis of the wicket gates indicate that a near infinite life can be expected for these components when they are subjected to normal design loads. Efficiencies of 90.7 and 91.4% in the generating and pumping modes, respectively, can be expected for the 500-MW, 1000-m-head unit. Performances of the other five machines are comparable. The specific costs of the pump turbines in mid-1978 US dollars per kW vary from 19.2 to 11.8 over a head range of from 500 to 1000 m for the 500-MW machines and from 20.0 to 12.3 for the 350-MW machines.

THERMAL

38204 (NCEI—0020) **Usefulness of North Carolina olivine in heat storage bricks.** Palmour, H.; Gay, B.M.; Cochrane, R.L. (North Carolina State Univ., Raleigh (USA). Engineering Research Services Div.). Jul 1980. 61p. NTIS, PC A04/MF A01.

Sensible heat storage systems are available which make use of low cost electric energy during off-peak hours to heat ceramic refractories to ~ 1500°F. Thereafter, heat is extracted as needed and without further energy demand (fan excluded) by controlled circulation of air through the core to meet residential or commercial space conditioning needs. Heat storage furnaces represent valuable load-leveling capabilities for central electric utilities and safe, convenient, reliable heat sources for consumers. The background of this new technology is reviewed, the different available types of heat storage furnaces are described, and attention is focused on materials selections, ceramic processing, thermal and mechanical properties and in-service performance factors for the ceramic refractories which make up the actual storage core. Prototype domestic heat storage refractories produced from North Carolina olivine (magnesium iron orthosilicate) are used as examples in discussing some of the available engineering options and tradeoffs, and their technical and economic consequences.

38205 (PNL—3471) **Aquifer thermal energy storage reference manual: seasonal thermal energy storage program.** Prater, L.S. (Battelle Pacific Northwest Labs., Richland, WA (USA)). 1980. Contract AC06-76RL01830. 77p. NTIS, PC A05/MF A01.

This is the reference manual of the Seasonal Thermal Energy Storage (STES) Program, and is the primary document for the transfer of technical information of the STES Program. It has been issued in preliminary form and will be updated periodically to include more technical data and results of research. As the program progresses and new technical data become available, sections of the manual will be revised to incorporate these data. This primary document contains summaries of: the TRW, incorporated demonstration project at Behtel, Alaska, Dames and Moore demonstration project at Stony Brook, New York, and the University of Minnesota demonstration project at Minneapolis-St. Paul, Minnesota; the technical support programs including legal/institutional assessment; economic assessment; environmental assessment; field test facilities; a compendia of existing information; numerical simulation; and non-aquifer STES concepts. (LCL)

BATTERIES

REFER ALSO TO CITATION(S) 38261

DESIGN AND DEVELOPMENT

38206 (ANL/OEPM—79-7) **Research, development and demonstration of lead-acid batteries for electric vehicle propulsion. Annual report, 1979.** Bodamer, G.W.; Branca, G.C.; Cash, H.R.; Chrastina, J.R.; Yurick, E.M. (Eltra Corp., Plymouth Meeting, PA (USA). C and D Batteries Div.). Jun 1980. Contract W-31-109-ENG-38. 92p. NTIS, PC A05/MF A01.

Progress during the 1979 fiscal year is reported. All the tooling and capital equipment required for the pilot line production has been installed. A limited amount of plate production has been realized. A highly automated and versatile testing facility was established. The fabrication and testing of the initial calculated design is discussed. Cell component adjustments and the trade-offs associated with those changes are presented. Cells are being evaluated at the 3-hour rate. They have a capacity of 165 Ah and an energy density of 36.5 Wh/kg, and have completed 105 cycles to date. Experimental results being pursued under the advanced battery development program to enhance energy density and cycle life are presented. Data

on the effects of different electrolyte specific gravity, separators, retainers, paste densities, battery additives and grid alloy composition on battery performance are presented and evaluated. Advanced battery prototype cells are under construction. Quality Assurance activities are summarized. They include monitoring the cell and battery fabrication and testing operations as well as all relevant documentation procedures. 12 figures, 28 tables.

38207 (ANL/OEPM—79-8) **Research, development, and demonstration of lead-acid batteries for electric vehicle propulsion. Annual report, 1979.** (Exide Management and Technology Co., Yardley, PA (USA)). Jun 1980. Contract W-31-109-ENG-38. 217p. NTIS, PC A10/MF A01.

The initial phase of work comprises three factorial experiments to evaluate a variety of component combinations. Goals to be met by these batteries include the following: capacity at 3 h discharge, 20 to 30 kWh; specific energy, 40 Wh/kg; specific power, 1000 W/kg for 15 s; cycle life, 800 cycles to 80% depth; price, $50/kWh. The status of the factorial experiments is reviewed. The second phase of work, design of an advanced battery, has the following goals: 30 to 40 kWh; 60 Wh/kg; 150 W/kg for 15 s; 1000 cycles to 80% depth; $40/kWh. It is not yet possible to say whether these goals can be met. Numerous approaches are under study to increase the utilization of battery chemicals. A battery design with no live electrical connection above the battery is being developed. 52 figures, 52 tables. (RWR)

38208 (ANL/OEPM—79-9) **Research, development and demonstration of lead-acid batteries for electric vehicle propulsion. Annual report, 1979.** (Globe-Union, Inc., Milwaukee, WI (USA)). Jun 1980. Contract W-31-109-ENG-38. 96p. NTIS, PC A05/MF A01.

This report describes work performed from October 1, 1978 to September 30, 1979. The approach for development of both the Improved State-of-the-Art (ISOA) and Advanced lead-acid batteries is three pronged. This approach concentrates on simultaneous optimization of battery design, materials, and manufacturing processing. The 1979 fiscal year saw the achievement of significant progress in the program. Some of the major accomplishments of the year are outlined. 33 figures, 13 tables. (RWR)

38209 (ANL/OEPM—79-10) **Research, development and demonstration of nickel-zinc batteries for electric vehicle propulsion. Annual report, 1979.** (Energy Research Corp., Danbury, CT (USA)). Jun 1980. Contract W-31-109-ENG-38. 187p. NTIS, PC A09/MF A01.

Progress achieved under ANL Contract No. 31-109-38-4248 from 16 August 1978 to 16 August 1979 is reported. The first segment of the overall program, component development, consists of four basic tasks proceeding in parallel: nickel electrode development, zinc electrode development, separator development, and sealed cell development. Each of these tasks is reported herein on a self-contained basis. System engineering is the second major subdivision of the effort. It includes the design and testing of all cells, the investigation of charge control devices and techniques, and the complete analysis of all cells for failure modes. It also encompasses the accelerated testing of 20-Ah cells. To date, large numbers of these cells (incorporating separator variations, active material additives and internal design variations) have been subjected to this type of testing. 48 figures, 47 tables. (RWR)

38210 (ANL/OEPM—79-11) **Research, development and demonstration of nickel-zinc batteries for electric vehicle propulsion. Annual report, 1979.** (Gould, Inc., Rolling Meadows, IL (USA)). Jun 1980. Contract W-31-109-ENG-38. 108p. NTIS, PC A06/MF A01.

This second annual report under Contract No. 31-109-39-4200 covers the period July 1, 1978 through August 31, 1979. The program demonstrates the feasibility of the nickel-zinc battery for electric vehicle propulsion. The program is divided into seven distinct but highly interactive tasks collectively aimed at the development and commercialization of nickel-zinc technology. These basic technical tasks are separator development, electrode development, product design and analysis, cell/module battery testing, process development, pilot manufacturing, and thermal management. A Quality Assurance Program has also been established. Significant progress has been made in the understanding of separator failure mechanisms, and a generic category of materials has been specified for the 300+ deep discharge (100% DOD) applications. Shape change has been reduced significantly. A methodology has been generated with the resulting hierarchy: cycle life cost, volumetric energy density, peak power at 80% DOD, gravimetric energy density, and sustained power. Generation I design full-sized 400-Ah cells have yielded in excess of 70 W/lb at 80% DOD. Extensive testing of cells, modules, and batteries is done in a minicomputer-based testing facility. The best life attained with electric vehicle-size cell components is 315 cycles at 100% DOD (1.0V cutoff voltage), while four-cell (~ 6V) module performance has been limited to about 145 deep discharge cycles. The scale-up of processes for production of components and cells has progressed to facilitate component production rates of thousands per month. Progress in the area of thermal management has been significant, with the development of a model that accurately represents heat generation and rejection rates during battery operation. For the balance of the program, cycle life of > 500 has to be demonstrated in modules and full-sized batteries. 40 figures, 19 tables. (RWR)

38211 (ANL/OEPM—79-14) **Research, development, and demonstration of nickel-iron batteries for electric vehicle propulsion. Annual report, 1979.** (Westinghouse Electric Corp., Pittsburgh, PA (USA)). Jun 1980. Contract W-31-109-ENG-38. 119p. NTIS, PC A06/MF A01.

The program has progressed to the stage of evaluating full-sized (220 Ah) cells, multicell modules, and 22 kWh batteries. Nickel electrodes that display stable capacities of up to 24 Ah/plate (at C/3 drain rate) at design thickness (2.5 mm) in tests at 200+ test cycles. Iron electrodes of the composite-type are also delivering 24 Ah/plate (at C/3) at target thickness (1.0 mm). Iron plates are displaying capacity stability for 300+ test cycles in continuing 3 plate cell tests. Best finished cells are delivering 57 to 63 Wh/kg at C/3, based on cell weights of the finished cells, and in the actual designed cell volume. 6-cell module (6-1) performance has demonstrated 239 Ah, 1735 Wh, 53 WH/kg at the C/3 drain rate. This module is now being evaluated at the National Battery Test Laboratory. The 2 x 4 battery has been constructed, tested, and delivered for engineering test and evaluation. The battery delivered 22.5 kWh, as required (199 Ah discharge at 113 V-bar) at the C/3 drain rate. The battery has performed satisfactorily under dynamometer and constant current drain tests. Some cell problems, related to construction, necessitated changing 3 modules, but the battery is now ready for further testing. Reduction in nickel plate swelling (and concurrent stack electrolyte starvation), to improve cycling, is one area of major effort to reach the final battery objectives. Pasted nickel electrodes are showing promise in initial full-size cell tests and will continue to be evaluated in finished cells, along with other technology advancements. 30 figures, 14 tables.

PERFORMANCE AND TESTING

REFER ALSO TO CITATION(S) 38877

38212 (GEPP-TIS—529) **Calcium/calcium chromate thermal battery and thermal battery assignment at the General Electric Neutron Devices Department.** Neale, J.B.; Walton, R.D. (General Electric Co., St. Petersburg, FL (USA). Neutron Devices Dept.). 10 Oct 1980. Contract AC04-76DP00656. 39p. NTIS, PC A03/MF A01.

A nontechnical overview of thermal battery design and fabrication methods is given, along with a description of the role of the General Electric Neutron Devices Department (GEND) in the Department of Energy's battery program. A thermal battery is a primary, reserve electrochemical power source; that is, it can be used only once and then for a relatively short period, measured in minutes. To energize the battery, an external electrical signal ignites a heat source in the battery to melt the electrolyte and initiate an electrochemical reaction. The battery is made up of several series-connected cells, each with an anode, a cathode, and a current collector. A cell's anode is calcium; its cathode is hexavalent chromium. The electrochemical reaction takes place when the electrolyte is melted by heat supplied from ignition of an iron-potassium perchlorate disk. Since no reaction occurs while the electrolyte is in the solid state, the battery does not deteriorate with time and has a shelf life exceeding 20 years. Presented are such critical battery operating characteristics as temperature, rise time, active life, current capacity, etc. Design factors described include size and shape, pellet density, ignition methods, anode construction, etc. These batteries are designed by Sandia National Laboratories, Albuquerque. GEND acts as a procurement agency and provides engineering support to suppliers. 18 figures.

38213 (SAND—80-0973C) **Testing of modified Li/SO_2 cells.** Levy, S.C.; Street, H.K.; Crafts, C.C. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 11p. (CONF-801067—1). NTIS, PC A02/MF A01.

From Lithium battery symposium; Hollywood, FL, USA (5 Oct 1980).

Long-term storage and discharge tests of lithium/sulfur dioxide cells indicated three specific failure modes resulting in premature failure. Further studies resulted in several potential solutions. Small lots of Li/SO_2 D cells incorporating different combinations of potential fixes were ordered from two manufacturers. These cells were placed on an accelerated test for approximately five months. After removal from the test, each cell was examined microscopically, and the relative merits of each fix were determined. Results of the accelerated test are discussed. 7 figures.

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 38325

38214 (DOE/RL/90369—8) **Research on alkaline zinc secondary electrodes with emphasis on model testing. Final report, June 15, 1976-August 31, 1979.** (Linfield Coll., McMinnville, OR (USA). Research Inst.). 1979. Contract AS06-76RL90369. 52p. NTIS, PC A04/MF A01.

The goal of this work was to obtain information useful in the improvement of life and performance of alkaline secondary cells utilizing porous zinc electrodes. Toward this end, experiments designed to test predictions of the most sophisticated mathematical models of the porous zinc electrode were performed. This approach is based on the conviction that the surest way to realize a significantly longer-lived zinc electrode is through better understanding of the electrode gained through the interaction between modeling and model revision based on feedback resulting from experimental testing of the models. Experiments performed have emphasized determination of the potential distribution over the surface of a flat rectangular porous zinc electrode operated under conditions of severly limited convective flow, the determination of potential distribution and concentration variations over the surface of similar electrodes when operated under normal flow conditions, and the evaluation of OH^- depletion as a failure mode in zinc electrodes operated under conditions of severely limited convective flow. Results of the experiments and interpretations of them in terms of the appropriate models are given. 17 figures, 5 tables.

38215 **Wall wick for nickel-hydrogen cell.** Rogers, H.H. US Patent 4,177,328. 4 Dec 1979. Filed date 19 Dec 1978. 5p.

Electrolyte, lost from the stack to the case in a sealed electrochemical cell, is returned to the stack by a zirconium oxide-based ceramic deposited on the inside wall of the pressure vessel, wicking by capillary action the electrolyte from regions external to the stack to the stack components. The ceramic wick is also used to transfer electrolyte from one separator and/or reservoir to another within the stack, replacing an interior stack wick in a recirculating design. The wall wick is also effective in a back-to-back type cell design

APPLICATIONS

REFER ALSO TO CITATION(S) 38877

ENERGY PLANNING AND POLICY

ENERGY PLANNING AND POLICY

ENERGY ANALYSIS AND MODELING

REFER ALSO TO CITATION(S) 37631, 38223, 38226, 38243, 38255, 38262, 38270, 38272

38216 (CONF-800820—12) **Vertical integration and market power.** Maddigan, R.J. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 26p. NTIS, PC A03/MF A01.

From American Statistical Society meeting; Houston, TX, USA (11 Aug 1980).

One of the continuing debates of industrial organization surrounds the importance of market structure in determining a firm's performance. This controversy develops naturally from the difficulties in measuring the relevant variables and the hazards of statistical analysis. The focus of this empirical study is the relationship between vertical integration, as an element of market structure, and market power, as a component of a firm's performance. The model presented in this paper differs from previous efforts because vertical integration is measured by the Vertical Industry Connections (VIC) index. VIC is defined as a function of the relative net interactions among the industries in which a firm operates, and is calculated by use of the national input-output tables. A linear regression model is estimated by means of a random sample of firms selected from the Standard and Poor's COMPUSTAT data base for 1963, 1967, and 1972. Combined cross-sectional, time-series methods are employed. The dependent variable is the price-cost margin; the independent variables include not only VIC, but also the concentration ratio, diversification index, value of assets, capital-output ratio, and sales growth. The results indicate that VIC is significant in increasing the price-cost margin, and thus support the hypothesis that vertical integration is a strategy to enhance market power. 1 figure, 3 tables.

38217 (DOE/CS/40178—1(Vol.2)) **Relevance of the Second Law of Thermodynamics to energy conservation.** (National Bureau of Standards, Washington, DC (USA); General Energy Associates, Cherry Hill, NJ (USA)). Jan 1980. Contract AT01-79CS40178. 275p. NTIS, PC A12/MF A01.

Use of the Second (2nd) Law of Thermodynamic concepts in energy system analysis is assessed. The basic advantage of using the 2nd law and availability concepts is that, while the First Law of Thermodynamics considers all energy quantities with equal weight, the 2nd law (and the entropy concept) distinguishes a grade or quality of the energy being considered as well as quantity. From this distinction flow two important considerations: (1) the losses at each point in a system can be assessed and measured in units that are directly proportional to input or purchased fuel energy; and (2) the minimum energy required to perform a given function or process is ascertainable as well as the maximum energy available from a given source. These considerations represent valuable analysis tools and compel consideration of the 2nd law in the analysis of energy systems. The use of 2nd law concepts is certainly not new or neglected. Practitioners in the energy field make implicit use of these ideas in the design and operation of most contemporary energy systems. The question is addressed here of whether explicit use of these ideas can provide any new or overlooked benefits in the design, operation, and reporting of energy using systems. To address the explicit use of 2nd law concepts, three areas of concern were chosen: energy monitoring; process and system design and modification; and component design and modification.

ECONOMICS AND SOCIOLOGY

REFER ALSO TO CITATION(S) 37550, 37632, 37642, 37889, 38228, 38229, 38238, 38239, 38240, 38250, 38263, 38273, 38274, 38728

38218 (PNL—3422) **Analysis of the results of Federal incentives used to stimulate energy production.** Cone, B.W.; Emery, J.C.; Fassbender, A.G. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1980. Contract AC06-76RL01830. 366p. NTIS, PC A16/MF A01.

The research program analyzed the Federal incentives used to stimulate nuclear, hydro, coal, gas, oil, and electricity production in order to supply what was learned to the selection of an incentives strategy to induce new energy production from renewable resources. Following the introductory chapter, Chapter 2 examines the problem of estimating effects from a theoretical perspective. Methods of quantifying and identifying the many interactive effects of government actions are discussed. Chapter 3 presents a generic analysis of the result of Federal incentives. Chapters 4 through 9 deal with incentives to energy forms - nuclear, hydro, coal, oil, gas, and electricity. Chapter 10 summarizes the estimated results of the incentives, which are presented in terms of their quantity and price impacts. The incentive costs per million Btu of induced energy production is also discussed. Chapter 11 discusses the parity issue, that is an equivalence between Federal incentives to renewable resources and to traditional energy resources. Any analysis of incentives for solar needs will profit from an analysis of the costs of solar incentives per million Btu compared with those for traditional energy forms. Chapter 12 concludes the analysis, discussing the history of traditional energy incentives as a guide to solar-energy incentives. 216 references, 38 figures, 91 tables.

38219 (PNL—3492) **Conceptual framework for describing selected urban and community impacts of federal energy policies.** Morris, F.A.; Marcus, A.A.; Keller, D. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Jun 1980. Contract AC06-76RL01830. 122p. NTIS, PC A06/MF A01.

A conceptual framework is presented for describing selected urban and community impacts of Federal energy policies. The framework depends on a simple causal model. The outputs of the model are impacts, changes in the state of the world of particular interest to policymakers. At any given time, a set of determinants account for the state of the world with respect to an impact category. Application of the model to a particular impact category requires: establishing a definition and measure for the impact category and identifying the determinants of these impacts. Analysis of the impact of a particular policy requires the following: identifying the policy and its effects (as estimated by others), isolating any effects that themselves constitute an urban and community impact, identifying any effects that change the value of determinants, and describing the impact with reference to the new values of determinants. This report provides a framework for these steps. Three impacts addressed are: neighborhood stability, housing availability, and quality and availability of public services. In each chapter, a definition and measure for the impact are specified; its principal determinants are identified; how the causal model can be used to estimate impacts by applying it to three illustrative Federal policies (domestic oil price decontrol, building energy performance standards, and increased Federal aid for mass transit) is demonstrated. (MCW)

ENVIRONMENT, HEALTH, AND SAFETY

REFER ALSO TO CITATION(S) 37515, 37647, 38273, 38650

NATURAL RESOURCES

REFER ALSO TO CITATION(S) 37800, 38249

38220 (DOE/TIC—11173) **HELIUM: a disappearing element. Strategies to prevent its irretrievable loss.** (Environmental Law Inst., Washington, DC (USA)). May 1979. Contract W-7405-ENG-36. 55p. NTIS, PC A04/MF A01.

Working from the premise that helium conservation is essential, information is presented on helium supply, current and future uses, helium extraction and storage, and helium valuation litigation. (LCL)

38221 (PB—80-132202) **Water supply should not be an obstacle to meeting energy development goals. Report to the Congress.** (General Accounting Office, Washington, DC (USA). Community and Economic Development Div.). 24 Jan 1980. 92p. NTIS, PC A05/MF A01.

This report disputes the common impression that the energy industry's thirst for water will create severe shortages throughout the water-short, energy-rich West. Recent evidence indicates that these predictions are unfounded or outdated and that adequate water is available for energy development through at least the year 2000.

RESEARCH, DEVELOPMENT, DEMONSTRATION, AND COMMERCIALIZATION

REFER ALSO TO CITATION(S) 37497, 37845, 38206, 38263, 39191

38222 (DOE/TIC—11288) **Importance of evaluating DOE energy conservation programs.** Hirst, E. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 12p. NTIS, PC A02/MF A01.

The need for the US DOE to conduct careful evaluations of its energy conservation programs is stressed, and the benefits from conducting such evaluations are discussed. It is concluded that DOE is not yet realizing these benefits because such evaluations have been rare. Changes in top management attitudes towards, and interest in, evaluation; provision of adequate staff and funds to conduct evaluations; attention to issues related to energy use data; and additional federal/state cooperation on evaluation would greatly strengthen DOE's activities related to evaluation of its conservation programs. The importance of energy conservation as a key element in the resolution of our energy problems requires us to do at least that much. (LCL)

NUCLEAR ENERGY

REFER ALSO TO CITATION(S) 37668, 37727, 37728, 38113, 38148, 38195, 38196, 38711, 39141

TRANSPORT AND STORAGE

REFER ALSO TO CITATION(S) 37634, 38279, 38326, 38330, 38331, 38535

WASTE HEAT UTILIZATION

REFER ALSO TO CITATION(S) 38073, 38306, 38311, 38312

38223 (EPRI-EA—1504) **Inclusion of cogeneration in electric utility models. Final report.** Foran, J.F.; Walters, A.S.; Bodington, J.C. (Resource Planning Associates, Inc., San Francisco, CA (USA)). Sep 1980. 100p. NTIS, PC A05/MF A01.

A computer model, RPACogen, was developed to examine some of the effects of cogeneration on a utility's cost-of-service, reliability, and other operations when it is teamed with a production-costing model. The model can also be used independently of a production-costing model to examine the cost and output of one cogeneration unit, or many different units together. In conjunction with a producing-costing model, RPACogen can be used to examine the effects of cogeneration on a utility's cost-of-service and reliability, and develop information to be used in examining alternative-ownership arrangements and ratemaking. RPACogen was designed to yield detailed information about the operations of cogeneration equipment during a specified period of time. It is not appropriate for use with a long-range capacity-expansion model; in order to use RPACogen in expansion planning, some additional capabilities such as a cogeneration unit's life cycle must be added. The principal model input is a description of the process-steam requirements that each cogeneration unit must satisfy. Using this information the model calculates the electrical capacity, investment and operating costs, and the thermal and electricity output of each unit over time. The model also calculates total costs and output for all cogeneration units combined. (The model can also summarize industrial groups that are specified by the user). The model will calculate these statistics for any of 34 different cogeneration units having different process steam outputs and fuel sources, or the user can override any and all calculations with optional inputs. These optional inputs allow the user to simulate any cogeneration unit, not only the archetypal units contained in the model.

CONSERVATION

REFER ALSO TO CITATION(S) 38217, 38278, 38283, 38289, 38291, 38304, 38305, 38307, 38308, 38317

38224 (PB—80-120520) **Design for evaluation of the CSA emergency energy conservation services program: operational problems impeding implementation of the CSA emergency energy conservation services program.** (Urban Systems Research and Engineering, Inc., Cambridge, MA (USA)). 18 Jul 1978. Contract CSA-B7B-5547. 60p. NTIS, PC A04/MF A01.

The report is organized into three main sections. Chapter 2.0 summarizes the major problem areas identified by respondents, provides background on the research, describes data collection techniques used, and comments on the nature and quality of the data base. Chapter 3.0 investigates whether the variation in Regional Office administration or grantee characteristics has influenced the identification of problems by grantees. Chapter 4.0 identifies those operational problems on which future action by CSA can have the most effect.

38225 (PB—80-121197) **Some major policy issues in the administration of a federal weatherization program.** (Urban Systems Research and Engineering, Inc., Cambridge, MA (USA)). 1978. Contract CSA-B7B-5547. 53p. NTIS, PC A04/MF A01.

This is a policy analysis paper that reviews the legislative and administrative history of Federal weatherization of low-income housing units.

SUPPLY, DEMAND, AND FORECASTING

REFER ALSO TO CITATION(S) 38218, 38228, 38230, 38239, 38243, 38252

38226 (EPRI-EA—1559) **Aggregate elasticity of energy demand. Final report.** (Stanford Univ., CA (USA). Energy Modeling Forum). Sep 1980. 67p. NTIS, PC A04/MF A01.

An Energy Modeling Forum working group conducted experiments to develop consistent estimates of the long-run aggregate elasticity of energy demand implicit in each of the 16 detailed models of the energy sector. That parameter is central to aggregate energy-policy analyses, and the study's results facilitate the comparison of the relationship between demand and prices in the models. The uncertainty in the estimates is emphasized but could not be quantified. The comparison of results is descriptive; there was no attempt to produce a single best estimate of the demand elasticity. However, comprehensive models, estimated statistically with historical data, seemed to produce larger aggregate elasticity estimates than other models.

38227 **Long range energy needs and price projections.** Sussman, S.S.; Rousseau, W.F. (Lawrence Livermore Lab., CA). pp 54-70 of Geothermal environmental seminar-'78. Tucker, F.L.; Tanner, L.R. (eds.). Clearlake Oaks, CA; Lake County Printing (1978).

From Geothermal seminar; Sacramento, CA, USA (9 May 1978).

Recently a national energy model that can assist in the analysis of the implications of various policy alternatives was completed. First some of the features of the new model and then some results of scenarios are presented. It should be emphasized that these scenarios are the results of preliminary work and do not necessarily represent the most recent judgment.

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 37808, 38218, 38219, 38226, 38234, 38235, 38255

38228 (BNL—51128) **Strategic cost-benefit analysis of energy policies: comparative analysis.** Davitian, H.; Groncki, P.J.; Kleeman, P.; Lukachinski, J.; Goettle, R.J. IV; Hudson, E.A. (Brookhaven National Lab., Upton, NY (USA). National Center for Analysis of Energy Systems). Oct 1979. Contract AC02-76CH00016. 37p. NTIS, PC A03/MF A01.

Current US energy policy includes many programs directed toward restructuring the energy system in order to decrease US dependence on foreign supplies and to increase our reliance on plentiful and environmentally benign energy flow. This study describes three possible energy strategies and analyzes each in terms of its economic, environmental, and national security benefits and costs. Each strategy is represented by a specific policy. In the first strategy no additional programs or policies are initiated beyond those currently in effect or announced. The second is directed toward reducing the growth in energy demand, i.e., energy conservation. The third promotes increased domestic supply through accelerated development of synthetic and unconventional fuels. The analysis focuses on the evaluation and comparison of these strategy alternatives with respect to their energy, economic, and environmental consequences. The results indicate that conservation can substantially reduce import dependence and slow the growth of energy demand, with only a small macroeconomic cost and with substantial environmental benefits; the synfuels policy reduces imports by a smaller amount, does not reduce the growth in energy demand, involves substantial environmental costs, and slows the rate of economic growth. These relationships could be different if the energy savings per unit cost for conservation are less than anticipated, or if the costs of synthetic fuels can be significantly lowered. Given these uncertainties, both conservation and RD and D support for synfuels should be included in future energy policy. However, between these policy alternatives, conservation appears to be the preferred strategy. The results of this study are presented in three reports: The Overview; The Detailed Projections; and The Comparative Analysis.

38229 (DOE/EIA—0201/17) **Energy programs/energy markets: technical papers.** (Department of Energy, Washington, DC (USA). Energy Information Administration). Jul 1980. 409p. NTIS, PC A18/MF A01.

This volume contains the technical details of the forecasting work of the energy policy study conducted during 1979 and 1980 by the Office of Applied Analysis, Energy Information Administration. A companion volume, Energy Programs/Energy Markets-Overview (DOE/EIA-0201/16), contains a description of the study, its background, and results. The first three chapters of this volume deal with the major energy supply markets; oil and gas, coal, and electricity. In each of these chapters, the focus is first on the effects of those Federal programs that are aimed primarily at the market for that particular fuel. Next, the discussion centers on the effects in that market (i.e., oil and gas, coal, and electricity) of Federal programs directed primarily at other energy markets. The consumer side of the energy market is discussed in Chapter 4. This chapter contains the analysis of various demand-management programs that attempt to encourage conservation. Chapter 5 describes a set of Federal programs that are designed to stimulate new supply technologies, whereas Chapter 6 analyzes one particular trade-off opportunity in the energy-environment interface. A list of acronyms, a glossary, and a complete index are included. This report is Volume 17 of the Energy Policy Study series. 11 figures, 37 tables.

38230 **California Energy Commission 1979 biennial report.** Sacramento, CA; California Energy Commission (1979). 72p. (NP—25018).

The California Energy Commission recommends a course of action to meet new electrical-generating capacity needs within the upcoming 12-year planning cycle. The Commission also provides policy recommendations for the the Commission, the governor, the legislature, and other state agencies to implement a transitional energy strategy to ensure that California's future electrical energy needs be met. In assessing the need, four components are identified: growth in demand; compensation for facility retirements; replacement of power currently transferred from the Pacific Northwest; and the necessity to displace utility oil and gas use by approximately 50% by 1990. Independent studies have shown that conservation and alternative energy resources have become economically and technically feasible, while the future monetary, social, and environmental costs of conventional energy sources such as oil and nuclear energy are in serious question. In the plans, though, conventional sources are not being abandoned, but are part of a mixed strategy which also develops alternative energy sources to guarantee uninterrupted energy supplies in the future.

38231 **Information choices and policies.** Tally, R.D.; Deultgen, R.R. (eds.). White Plains, NY; Knowledge Industry Publications, Inc. (1979). 412p. (CONF-7910144—).

From 42. annual meeting of the American Society for Information Science; Minneapolis, MN, USA (14 Oct 1979).

Nine of the articles in these proceedings were chosen for inclusion in the TIC data base. Of these, one has been announced in ERA, and three have been announced in ATOMINDEX. Separate abstracts were prepared for each citation. No individual articles have been cited in EAPA. (RWR)

38232 **Industry perspective of public relations.** Russell, R.M. pp 43-49 of Geothermal environmental seminar-'78. Tucker, F.L.; Tanner, L.R. (eds.). Clearlake Oaks, CA; Lake County Printing (1978).

From Geothermal seminar; Sacramento, CA, USA (9 May 1978).

Issues are discussed involving relationships between people in the areas of the environment, government agencies, energy in general, inter- and intra-industry relationships, and inter- and intra-agency relationships. (MHR)

FOSSIL FUELS

REFER ALSO TO CITATION(S) 37558

COAL

REFER ALSO TO CITATION(S) 37483, 37497, 37549, 37550, 37557, 37559, 37578, 37592, 38236, 38728

38233 (ANL/ECT—9) **Assessment of energy and economic impacts of particulate-control technologies in coal-fired power generation.** (Argonne National Lab., IL (USA); Midwest Research Inst., Kansas City, MO (USA)). Apr 1980. Contract W-31-109-ENG-38. 249p. NTIS, PC A11/MF A01.

Under contract to Argonne National Laboratory, Midwest Research Institute has derived models to assess the economic and energy impacts of particulate-control systems for coal-fired power plants. The models take into account the major functional variables, including plant size and location, coal type, and applicable particulate-emission standards. The algorithms obtained predict equipment and installation costs, as well as operating costs (including energy usage), for five control devices: (1) cold-side electrostatic precipitators, (2) hot-side electrostatic precipitators, (3) reverse-flow baghouses, (4) shake baghouses, and (5) wet scrubbers. A steam-generator performance model has been developed, and the output from this model has been used as input for the control-device performance models that specify required design and operating parameters for the control systems under study. These parameters then have been used as inputs to the cost models. Suitable guideline values have been provided for independent variables wherever necessary, and three case studies are presented to demonstrate application of the subject models. The control-equipment models aggregate the following cost items: (1) first costs (capital investment), (2) total, first-year annualized costs, and (3) integrated cost of ownership and operation over any selected plant lifetime. Although the models have been programmed for rapid computation, the algorithms can be solved with a hand calculator.

38234 (EPA—600/7-79-111a) **Integrated assessment of Texas lignite development. Volume I. Technical analyses.** (Radian Corp., Austin, TX (USA)). Apr 1979. 396p. NTIS, PC A17/MF A01.

This report considers the fuel supplies available to Texas to 2000 A.D., the competitiveness of lignite for certain uses, site selection problems and environmental and socio-economic factors related to large scale lignite development. (LTN)

38235 (EPA—600/7-79-111b) **Integrated assessment of Texas lignite development. Volume II. Policy analysis.** (Radian Corp., Austin, TX (USA)). Apr 1979. 204p. NTIS, PC A10/MF A01.

This volume deals specifically with eighteen issues arising from the analysis presented in the preceding four chapters. These issues fall into three groups. The first contains issues which set the regulatory context into which lignite development must be fitted. These issues must be resolved at the federal level. The second group consists of issues concerning the allocation of resources, generally resolvable principally by state action. The third group deals with anticipated problems in dealing with the impacts of lignite development. It is divided into issues arising over possible needs for new initiatives to protect environmental and socioeconomic values, and issues over the implementation of laws already in place. Alternatives available to resolve the issues are discussed specifically. Four key underlying issues that tie together the eighteen are also identified. These include: limitations in requirements for comprehensive environmental review; the present incomplete internalization of the costs of chronic health impacts, ecological and aesthetic damage; the

difficulty for firms of long-range planning under conditions of regulatory uncertainty; and the conflict between equity and economic efficiency in resource allocation.

PETROLEUM

REFER ALSO TO CITATION(S) 37598, 37631, 37632, 37634, 38241, 38287, 38293

38236 (DOE/IA—0010/3) **International energy indicators.** Bauer, E.K. (ed.). (Department of Energy, Washington, DC (USA). Office of Current Reporting). Sep 1980. 30p. NTIS, PC A03/MF A01.

Data are compiled and graphs are presented for Iran: Crude Oil Capacity, Production and Shut-in, 1974-1980; Saudi Arabia: Crude Oil Capacity, Production and Shut-in, 1974-1980; OPEC (Ex-Iran and Saudi Arabia): Capacity, Production and Shut-in, 1974-1980; Non-OPEC Free World and US Production of Crude Oil, 1973-1980; Oil Stocks: Free World, US, Japan and Europe (landed), 1973-1980; Petroleum Consumption by Industrial Countries, 1973-1980; USSR Crude Oil Production, 1974-1980; Free World and US Nuclear Generation Capacity, 1973-1980; US Imports of Crude Oil and Products, 1973-1980; Landed Cost of Saudi Crude in Current and 1974 Dollars; US Trade in Bituminous Coal, 1973-1980; Summary of US Merchandise Trade, 1976-1980; and Energy/GNP Ratio.

38237 (DOE/OSE—0002) **Office of oil and natural gas supply development.** Buck, A.L. (Department of Energy, Washington, DC (USA)). Aug 1980. 41p. NTIS, PC A03/MF A01.

From its origin in the Department of the Interior until its transfer to the Federal Energy Office in December 1973, the Office of Oil and Gas served as the focal point for the coordination of all of the federal government's many interests in oil and gas. A sttaff agency, reporting originally to the Secretary of the Interior and later to the Assistant Secretary for Mineral Resources, it was responsible for providing the data and knowledge upon which oil and gas policy at various levels of the government was formulated. It was an effective channel of communication with the appropriate state agencies, with the domestic oil and gas industry, and with international organizations concerned with the supply of oil and gas. Working through a complicated system of industry-government committees, the office was responsible for the production of an enormous volume of significant reports through the years. It was the action agency for emergency preparedness, providing the Secretary of the Interior with a capability to respond effectively to emergencies, both large and small, which might affect the nation's supply of oil and gas. In the 27-year history of the Office of Oil and Gas, the emergency readiness functions emerge as by far the most absorbing of its many concerns. The events and actions of the office, during those times when instability in the Middle East and around the world threatened to interrupt the flow of petroleum, make interesting studies of the unique cooperation between the federal government and an industry so essential to the nation's well-being.

38238 **Crude oil resource appraisal in the United States.** Uri, N.D. (Dept. of Energy, Washington, DC). *Energy J.;* **1**: No. 3, 65-74(Jul 1980).

Past experience supported an optimistic view of US oil resources prior to the Arab embargo of 1973, although some were aware that exploration and production were declining. An approach to estimating producible reserves, combining the engineering and econometric techniques, uses geologic estimates and a structural model to project when production will peak, the quantity that will be produced, and the time distribution of production. The results indicate that aggregate production will increase with the real price of oil. At $45 per barrel, 20 to 30 billion more barrels will be produced. 18 references. (DCK)

38239 **Prospects for OPEC five years after 1973/74.** Gately, D. (New York Univ., NY). *Eur. Econ. Rev.;* **12**: No. 4, 369-379(Oct 1979).

This paper surveys more than a dozen models of Organization of Petroleum Exporting Countries (OPEC) and world energy markets that have appeared since 1976. Included are simulation models, optimization models, and analyses of energy balances. Attention is focused on the outlook for OPEC prices and the demand for OPEC oil exports over the next fifteen years. Virtually all analyses agree that substantial changes from cufrent market conditions are unlikely over the next few years. Beyond 1985, however, some project a severe tightening in world oil markets, while others project no such change from current conditions. 29 references.

NATURAL GAS

REFER ALSO TO CITATION(S) 37631, 37642, 37647, 38237

38240 (DOE/PE/04505—1) **Agreement to provide energy planning, analysis, and evaluation. Final report.** (Institute of Gas Technology, Chicago, IL (USA)). Mar 1980. Contract AC02-77PE04505. 82p. NTIS, PC A05/MF A01.

IGT conducted and prepared three separate analyses requested by DOE. These analyses are: Incremental Pricing and LNG Projects; Cooperative Arab/Israeli Energy Programs Based on Natural Gas; and An Examination of FEA Region 5 with Regard to the Natural Gas Policy Act of 1978. An incremental pricing requirement on LNG would substantially reduce the number of customers who would be willing to contract for LNG on a long-term basis. This will make the financing of projects difficult and would lower the number of future projects to at least one-tenth of those currently projected. For those customers who were forced into the contracts because of unavailability of alternatives, there would be long-run dislocations as in the case of the process and feedstock customers, or simply high fuel bills in the case of the high-priority customers. An additional result would be greater oil and LPG imports. Specific pieces of federal energy legislation, such as the Natural Gas Policy Act of 1978 (NGPA), will have a varying impact in the individual regions of the country. A profile of the Federal Energy Administration (FEA) Region 5 was constructed such that when data are available, the impacts of the NGPA can be quantified. Four types of ventures appear to have the best potential in gaining support and promoting regional benefits in possible cooperative programs between the Arabs and Israelis. These are: development and use of a regional pipeline network to provide natural gas as a fuel in the residential, commercial, industrial, and power generation sectors; construction and operation facilities to export natural gas to Europe as LNG or by means of a pipeline system that would join with the trans-Mediterranean pipeline; production of chemical feedstocks which would form the basis for regional industrial development including the manufacture of finished products; and production of chemical feedstocks and liquid fuels for export.

OIL SHALES AND TAR SANDS

REFER ALSO TO CITATION(S) 37650

HYDROGEN AND SYNTHETIC FUELS

REFER ALSO TO CITATION(S) 38349

ELECTRIC POWER

REFER ALSO TO CITATION(S) 38057, 38230, 38272, 38310

38241 (DOE/EIA/AR—0238) **Impact of 1980 scheduled capacity additions on electric-utility oil consumption.** Gielecki, M.; Clark, G.; Roberts, B. (Department of Energy, Washington, DC (USA). Energy Information Administration). Aug 1980. 37p. NTIS, PC A03/MF A01.

The electric-utility sector currently consumes approximately 8% of the total oil used in the Nation. This oil represented about 15% of total fuel consumed by electric utilities in 1979. Two important factors that affect the level of utility oil consumption in 1980 are the substantial increase in coal-fired generating capacity and the uncertainty surrounding nuclear-plant licensing. With particular emphasis on these considerations, this report analyzes the potential for changes in electric-utility oil consumption in 1980 relative to the 1979 level. Plant conversions, oil to coal, for example, that may occur in 1980 are not considered in this analysis. Only the potential reduction in oil consumption resulting from new generating-capacity additions is analyzed. Changes in electric-utility oil consumption depend on, among other factors, regional-electricity-demand growth and generating-plant mix. Five cases are presented using various electricity-demand-growth rate assumptions, fuel-displacement strategies, and nuclear-plant-licensing assumptions. In general, it is likely that there will be a reduction in electric-utility oil consumption in 1980. Using the two reference cases of the report, this reduction is projected to amount to a 2 to 5% decrease from the 1979 oil-consumption level; 7% reduction is the largest reduction projected.

38242 (DOE/RA/04934—42) **Two economic papers: I. Monopsony power and the supply of power from small generating stations; II. A preliminary economic analysis of the value of contributions by small dams to system generation reliability.** (Energy Law Inst., Concord, NH (USA). Franklin Pierce Law Center). May 1980. Contract AS02-78RA04934. 33p. NTIS, PC A03/MF A01.

A small, private developer of an electric-generation station without an immediate demand for his output must sell his power through the transmission and distribution system of the electric utility within whose service area the developer's station is located. This effective control of the market (through the ownership of the local grid) provides the utility with monopsony buying power over potential suppliers of electric generation. What this power implies in

the small-station-generator market, in the retail market, and to the development of the small power production is examined in Economic Paper I. The analysis shows the associated deadweight loss in that market and the final product attributable to the monopsony power. In Economic Paper II, a framework is established that determines the value of capital for capacity when that capacity does not necessarily produce electricity, but is in place to assure system reliability. The Energy Law Institute believes it is reasonable to view small dams, even with highly varying outputs, as positively contributing to system reliability and that the supplier should be remunerated.

38243 (DOE/RA/29999—01) **Analysis of the need for intermediate and peaking technologies in the year 2000.** Barrager, S.M.; Campbell, G.L. (Decision Focus, Inc., Palo Alto, CA (USA)). Apr 1980. Contract AC02-79ET29999. 255p. NTIS, PC A12/MF A01.

This analysis was conducted to assess the impact of load management on the future need for intermediate- and peak-generating technologies (IPTs) such as combustion turbines, pumped storage, and cycling coal plants. There will be a reduced need for IPTs if load-management activities such as time-of-use pricing, together with customer-owned energy-storage devices, hot-water-heater controls, and interruptible service, can economically remove most of the variation from electric-power demands. Therefore, the analysis assesses the need for IPTs in an uncertain future, which will probably include load management and time-differentiated electricity prices. Section 2 provides a condensed description of the models used in the analysis. (Details and data sets are contained in the appendixes.) Results of sensitivities on growth rates, model parameters, and appliance saturations are discussed in Section 3, which also contains the analysis of the potential impacts of customer energy storage, appliance control, and time-of-use pricing. The future need for intermediate and peaking technologies is analyzed in Section 4.

38244 (DOE/RG/00335—01) **Discussion series on PURPA related topics: metering.** Sturgeon, J.I. (City Utilities of Springfield, MO (USA); Missouri Univ., Kansas City (USA)). Aug 1980. Contract FC01-77ZZ00335. 119p. NTIS, PC A06/MF A01.

Time-differentiated metering of electricity consumption and demand is required in both rate-structure experimentation and the implementation of most time-of-use rate designs. Time-differentiated metering takes three major forms: multi-register watthour meters, magnetic-tape recording meters, and remote automatic meter-reading systems. The majority of projects selected magnetic-tape meters for their flexibility with respect to rate structure, load-survey capabilities, and ready availability. The small-scale, experimental nature of the projects reduced the significance of the large difference in per-unit cost and operational/maintenance complexity between this form of metering and the multi-register form. Magnetic-tape meters are not likely candidates for system-wide implementation of time-differentiated metering. Automatic remote-meter-reading systems were not adequately available during the project years; those projects attempting to use these were unable to bring them to full operational status before project termination, due to the many problems of design, quality control, and equipment acquisition encountered. Delays in acquisition and problems of quality control also followed the selection of magnetic-tape meters and multi-register meters by a number of the projects. Though less complex than automatic remote-reading systems, these technologies are still new and more complex than standard watthour metering. Thus, both equipment vendors and utilities encountered numerous problems in getting properly functioning meters to the service entrances on time. A variety of factors contributed to installation delays, including unforeseen space limitations, incompatible wiring, problems of task organization, and customer reluctance.

38245 (DOE/RG/06568—T1) **Office of Consumer Services grant program. Final report.** (Indiana State Office of Public Counselor, Indianapolis (USA)). 15 May 1980. Contract FG01-78RG06568. 32p. NTIS, PC A03/MF A01.

The report contains a narrative description of the accomplishments of the Office of Public Counselor Services as a result of the Office of Consumer Services Grant Program. The Grant was awarded to the Office of the Public Counselor to supplement and increase an ongoing activity of consumer intervention and representations, and provide accurate studies related to electric utilities regarding its load and demands for future periods. Program accomplishments are described for Southern Indiana Gas and Electric Rate Case; Northern Indiana Public Service Company; Indiana and Michigan Electric Company and an appeal; Indianapolis Power and Light Company; Load Research and Demand Study; and Indiana Coal Reserves Study. A timetable of major program events is shown. The final financial status report and the assessment of program effectiveness are presented.

38246 (ORNL—5655) **Dynamic model of power system operation incorporating load control.** Kuliasha, M.A. (Oak Ridge National Lab., TN (USA)). Oct 1980. Contract W-7405-ENG-26. 161p. NTIS, PC A08/MF A01.

Load management has been proposed as a means whereby an electric utility can reduce its requirements for additional generation, transmission, and distribution investments, shift fuel dependency from limited to more abundant energy resources, and improve the efficiency of the electric energy system. There exist, however, serious technological and economic questions which must be answered to define the cost trade-offs between initiating a load management strategy or adding additional capacity to meet the load. One aspect of this complex problem is to determine how the load profile might be modified by the load management option being considered. Towards this end, a model has been developed to determine how a power system with an active load control system should be operated to make the best use of its available resources. The model is capable of handling all types of conventional generating sources including thermal, hydro, and pumped storage units, and most appliances being considered for direct control including those with inherent or designed storage characteristics. The model uses a dynamic programming technique to determine the optimal operating strategy for a given set of conditions. The use of the model is demonstrated. Case study results indicate that the production cost savings that can be achieved through the use of direct load control are highly dependent on utility characteristics, load characteristics, storage capacity, and penetration. The load characteristics that produce the greatest savings are: large storage capacity; high coincidence with the system peak; large connected load per point; and moderately high diversity fraction.

38247 (PB—80-124308) **Residential electricity demand in Colorado municipalities: a time-series cross-section study. Doctoral thesis.** Snyder, J.J. (National Center for Atmospheric Research, Boulder, CO (USA)). Jun 1979. 279p. NTIS, PC A13/MF A01.

The study is based on fifteen years of annual data for each of thirty-six Colorado Municipalities. In addition to average electricity prices, actual residential electric rate structures used each year in each community were recorded. 'Marginal zone prices' were developed from the rare structures in order to eliminate the simultaniety bias in price elasticity estimates when average price is used. The results suggest that previous estimates of own-price elasticity, based on average price, may be overstated by as much as a factor of two. The estimates of long-run electricity price elasticity obtained here for Colorado range from -0.4 to -0.9 in contrast to previous average electricity price elasticities based on national data which range from -1.1 to -201.

38248 **Electric utility rate design study: lessons in load management.** Palo Alto, CA; Electric Power Research Institute (1980). 105p. (NP—22590).

A dozen utilities' attempts to plan, adopt, and evaluate various load-management techniques are described briefly. These range from time-of-day pricing for large industrial customers to the direct radio control of residential water heaters. The kinds of utilities surveyed encompass very-large privately-owned multicompany systems as well as small-sized municipally-operated companies. Two common-sense lessons stand out: (1) it takes two or three years to plan and conduct a load-management test of even the smallest size; and, (2) although experimental results are often quite modest, most seem favorable - given a wide spectrum of objectives. Another lesson, although there are exceptions, is that data can be collected faster than utilities can analyze the information. Often the data and analysis are such that firm conclusions are difficult to draw. Overall, it appears that utilities take rather-small first steps but are willing to increase their commitments over time. Even though the peak-shaving and load-shifting effects, in the short run, are small, the results appear beneficial.

ELECTRIC POWER GENERATION

REFER ALSO TO CITATION(S) 37800, 37808, 37809, 38223, 38236, 39206

38249 (DOE/RA/23220—3) **Case studies of the legal and institutional obstacles and incentives to the development of small-scale hydroelectric power: South Columbia Basin Irrigation District, Pasco, Washington.** Schwartz, L. (Franklin Pierce Law Center, Concord, NH (USA)). May 1980. Contract FG03-78RA23220. 86p. NTIS, PC A05/MF A01.

The case study concerns two modern human uses of the Columbia River - irrigation aimed at agricultural land reclamation and hydroelectric power. The Grand Coulee Dam has become synonomous with large-scale generation of hydroelectric power providing the Pacific Northwest with some of the least-expensive electricity in the United States. The Columbia Basin Project has created a half-million acres of farmland in Washington out of a spectacular and vast desert. The South Columbia River Basin Irrigation District is seeking to harness the energy present in the water which already runs through its canals, drains, and wasteways. The South District's development strategy is aimed toward reducing the costs its farmers pay for irrigation and raising the capital required to

serve the remaining 550,000 acres originally planned as part of the Columbia Basin Project. The economic, institutional, and regulatory problems of harnessing the energy at site PEC 22.7, one of six sites proposed for development, are examined in this case study.

38250 (EPRI-WS—79-237) **Proceedings: workshop on water supply for electric energy.** (Linsley, Kraeger Associates, Aptos, CA (USA)). Aug 1980. 94p. (CONF-8003103—). NTIS, PC A05/MF A01.

From Workshop on water supply for electric energy; Palo Alto, CA, USA (19 Mar 1980).

A workshop was held to develop recommendations on research needed to help the electric-utility industry meet its needs for water. Seven priority research areas were defined and twenty other research topics identified. These are described in this report. The major emphasis of the suggested research is in the socio-economic and legal aspects of water use for electric-energy production. Several papers presented as a basis for discussion are reproduced in full. These include papers by Linsley (Water Availability), Ortolano (Public Participation in Planning), Gjelde (Economics), Love (Social Effects Assessment), and Trelease (Water Law). The priority research topics are: alternate sources of cooling water; instream water requirements; public participation in planning; estimates of potential hydroelectric energy; slurry transport of coal; strategies for coping with drought; and the socio-economic basis for resource allocation.

CONSUMPTION AND UTILIZATION

REFER ALSO TO CITATION(S) 38270, 38274, 38287, 38291

38251 (SAND—80-1774) **Commuting practices and attitudes at Sandia National Laboratories in 1980.** Stone, D.C.; Rigby, L.V.; McClaflin, R.S.; Champion, B.J. (Sandia Labs., Albuquerque, NM (USA)). Sep 1980. Contract AC04-76DP00789. 77p. NTIS, PC A05/MF A01.

This report presents the results of a commuting survey administered by mail to a random sample of Sandia National Laboratories, Albuquerque employees in March 1980. The results are based on 1,088 usable returns sorted by nine basic criteria including area of residence, distance from work site, and general occupation classification. The text describes the current status of commuting practices, fuel usage, potential for increased ridesharing, and employee attitudes. Appendices provide the original questionnaire, tables of detailed results, and summary of write-in comments.

UNCONVENTIONAL SOURCES AND POWER GENERATION

REFER ALSO TO CITATION(S) 38309

38252 **Present value: constructing a sustainable future.** Sacramento, CA; Office of Appropriate Technology (1979). 49p. (NP—24995). Free.

A variety of practical methods for using renewable energy sources to take advantage of climatic conditions for heating and cooling are presented. The examples demonstrate that energy saving homes, commercial buildings, and entire communities are economically feasible and perform as efficiently as traditional methods. Specific methods using solar energy described are: active and passive solar techniques; Hewlett-Packard Building; Hollandale Dairy; the Renault and Handley Solar Building; a thermal storage building system; solariums and greenhouses; integrating a solarium into a new home; adding an attached solar greenhouse. Specific buildings described in California are: the Greenstein, the Dave Smith, the Tom Smith, the Harmon, and the Hodam residences; the Terman Engineering Center; Site One; and Village Homes.

SOLAR

REFER ALSO TO CITATION(S) 37812, 37814, 37876, 37878, 37879, 37884, 37889, 37895, 38218

38253 **Economic effects of increased penetration of solar energy.** Hudson, E.A. (Dale W. Jorgenson Associates, Cambridge, MA). *Energy J.*; 1: No. 3, 97-111(Jul 1980).

The impact that penetration by the solar-energy industry and other new energy-technology sources to 20 percent of the market is analyzed in terms of its effect on real economic growth. Two sets of effects are examined: the impact on investment and capital requirements and the impact on total income and output. New technology energy sources are linked to the general economy because they divert the inputs and outputs of conventional sources and of economic resources to other uses and, it is shown, will result in a slower growth of real incomes and output as long as these technologies cost more than the energy derived from conventional sources. Policies for developing a large-scale solar program must weigh the potential benefits of reduced oil imports and environmental damage with the substantial economic costs. These costs suggest that a commercialization program is premature. 8 references. (DCK)

38254 **Sun as a partner in design.** Harris, M. *Living Alternatives;* 1: No. 7, 58-62(Mar 1980).

The author states the following: "Today, with simple, low-technology, relatively low-cost designs, solar contractors and do-it-yourselfers are now able to meet some 50 to 80% of a new shelter's heating requirements with simple active or, in some cases, totally passive systems. Simple retrofits can easily provide 25% of an existing home's heat from solar sources. The economical, ecological and spiritual benefits of deriving energy from the sun are available to all. The sun shines in everybody's backyard; its energy can be used by anyone willing to cultivate basic building skills and an awareness for new discoveries and personal adaptations of existing solar designs." After outlining the principles and citing several examples, he notes, in conclusion, "While each individual shelter presents a unique solar-design problem, it's a rare home indeed that cannot incorporate some low-cost system to make use of the energy showered on it by the sun."

GEOTHERMAL

REFER ALSO TO CITATION(S) 37889, 37915, 37929, 37931, 37958, 37959, 37960, 37961, 37962, 37963, 37965, 37966, 37968, 37971, 37972, 37973, 37974, 37983, 37984, 38000, 38042, 38043

OTHER

REFER ALSO TO CITATION(S) 37839, 37845, 37848, 38047, 38048

38255 **Hilltown Energy Project.** Lowitt, P. *Living Alternatives;* 1: No. 7, 54-58(Mar 1980).

The Hilltown region of western Massachusetts is typical of many rural areas in this country. It exports its goods, services, and capital, while it imports much of its energy. The drain of monetary resources used for energy purchases prompted the Hilltown Energy Project. The project is attempting to slow the flow of money out of the region by developing sources of energy within the area, such as wind, wood, water, and solar power, and by promoting public involvement in energy conservation and energy policymaking. The initial lack of public enthusiasm for the project, according to the project director, did not reflect a lack of concern but a sense of powerlessness about energy issues. Subsequently, instead of direct public participation, the project involved the energy coordinators in each of the nine towns in the region. Energy statistics for the region were collected using traditional and nontraditional means. An evaluation of the statistics indicated that local sources of hydropower could supply all of the electrical needs of the region, with two wood-fired generators as backup. To convince the skeptical people of the region, the director has instituted practical projects to demonstrate the validity of the study. The project results will define an energy plan for the nine hill towns. 2 figures. (SAC)

DIRECT ENERGY CONVERSION

REFER ALSO TO CITATION(S) 39166

MHD GENERATORS

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 38392

38256 (DOE/ET/10816—T1(Vol.1), pp 56-148) **Corrosion studies of MHD preheater materials.** Kitto, K. 1978.

In MHD power generation: research, development and engineering. Annual progress report, October 1977-September 1978.

Slag and slag-seed corrosion tests have been conducted at elevated temperatures on a number of ceramic refractory materials which have potential use in MHD preheater units. Laboratory tests were conducted as a function of elapsed time at temperatures between 1500°C and 1600°C in a synthetic four-component slag and a slag-seed containing 15 weight percent K_2SO_4; ambient atmospheres were both air and a simulated combustion atmosphere. A dynamic dipping test was used wherein there was forced fluid flow past the refractory surface. Of the materials tested, chrome-containing commercial refractories were the most corrosion resistant, followed by alumina, magnesia-alumina spinel, and finally, magnesia. Photomicrographic and microprobe analyses of corroded materials provided insight into the processes of corrosion. There appears to be no

correlation between the degree of corrosion and slag penetration for several of the materials. Penetration of slag appears to occur along grain boundaries and into pore regions for some of the materials. For single crystals and fully dense polycrystalline materials, there was no slag penetration, and the rate of diffusion of slag species was very low. The creep apparatus has been redesigned partially, and system assembly has continued as various components have been received. Development of a new pre-corrosion technique has begun. Work on the control of the creep system by a microprocessor has continued. Assembly of interface boards has continued, and work on the software control programs has begun. Actual experimental running conditions of the creep apparatus will be set to simulate the anticipated preheater conditions.

THERMIONIC CONVERTERS

38257 (DOE/ET/15423—4) **Application of microfabrication technology to thermionic energy conversion. Progress report 4, 1 May 1980 to 31 July 1980.** Brodie, I. (SRI International, Menlo Park, CA (USA)). 5 Sep 1980. Contract AC02-79ET15423. 10p. NTIS, PC A02/MF A01.

Two applications of microfabrication technology to thermionic converters have been investigated theoretically. The first is a novel method of maintaining micron or submicron spacings over large areas (>1 cm^2), using metals of different expansion coefficients to eliminate the shear stresses on the insulating pillars separating the electrodes. The second uses low-voltage field-emission sources to create ions in a large (~ 1 mm) interelectrode gap for space charge neutralization. The theoretical results for both these approaches are highly encouraging.

DESIGN AND DEVELOPMENT

38258 (COO—3056-54) **Manufacturing cost of flame heated thermionic converters. Topical report.** LaRue, G.; Miskolczy, G. (Thermo Electron Corp., Waltham, MA (USA)). Apr 1979. Contract AC02-76ET11292. 28p. (TE—4258-163-79). NTIS, PC A03/MF A01.

The cost of thermionic converters has been estimated in support of the cost calculations for thermionic topping of central station powerplants. These calculations supersede the previous calculations made in 1975 and use a design concept similar to the current configuration of flame-heated converters. The cost of converters was estimated by obtaining quotations from manufactureres whenever possible. The selling cost was found to be $110 per kilowatt.

FUEL CELLS

38259 (DOE/TIC—3359(Suppl.1)) **Fuel cells: a bibliography.** (Department of Energy, Oak Ridge, TN (USA). Technical Information Center). Jul 1980. 239p. NTIS, PC A11/MF A01.

This compilation includes 1067 citations of foreign and domestic reports, journal articles, patents, conference papers and proceedings, monographs, and books on fuel cells. The citations were taken from the DOE Energy Data Base covering the period June 1977 through June 1980. The citations are arranged in subject categories. Within each category the report citations are arranged alphanumerically by report number, and nonreport literature citations are arranged in inverse chronological order. Corporate Author, Personal Author, Subject, Contract Number, and Report Number indexes are provided. (WHK)

DESIGN AND DEVELOPMENT

38260 (DOE/ET/15440—2) **Development of molten carbonate fuel cell power plant technology. Quarterly technical progress report No. 2, January 1-March 31, 1980.** (United Technologies Corp., South Windsor, CT (USA). Power Systems Div.). Aug 1980. Contract AC01-79ET15440. 93p. NTIS, PC A05/MF A01.

The overall objective of this 29-month program is to develop and verify the design of a prototype molten carbonate fuel cell stack which meets the requirements of 1990's competitive coal-fired electrical utility central station or industrial cogeneration power plants. During this quarter, effort was continued in all four major task areas: Task 1 - system studies to define the reference power plant design; Task 2 - cell and stack design, development and verification; Task 3 - preparation for fabrication and testing of the full-scale prototype stack; and Task 4 - developing the capability for operation of stacks on coal-derived gas. In the system study activity of Task 1, preliminary module and cell stack design requirements were completed. Fuel processor characterization has been completed by Bechtel National, Inc. Work under Task 2 defined design approaches for full-scale stack busbars and electrical isolation of reactant manifolds and reactant piping. Preliminary design requirements were completed for the anode. Conductive nickel oxide for cathode fabrication has been made by oxidation and lithiation of porous nickel sheet stock. A method of mechanizing the tape casting process for increased production rates was successfully demonstrated under Task 3. In Task 4, theoretical calculations indicated that hydrogen cyanide and ammonia, when present as impurities in the stack fuel gas, will have no harmful effects. Laboratory experiments using higher than anticipated levels of ethylene showed no harmful effects. Components for the mobile test facility are being ordered.

PERFORMANCE AND TESTING

REFER ALSO TO CITATION(S) 38260

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 37492

ELECTROCHEMISTRY, MASS TRANSFER, AND THERMODYNAMICS

38261 (ORNL—5665, pp 101-110) **Molten salt systems.** Jul 1980.

In Chemistry Division annual progress report, February 29, 1980.

Research is reported on: molten carbonate fuel cell program (Li_2CO_3-K_2CO_3), transport and thermodynamics ($AgNo_3$-$NaNO_3$), and molten salt battery program (LiCl-KCl). 5 figures, 3 tables. (DLC)

ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

REFER ALSO TO CITATION(S) 38217, 38222

BUILDINGS

REFER ALSO TO CITATION(S) 38224, 38252

38262 (DOE/CS—0171) **Predesign energy analysis.** (Department of Energy, Washington, DC (USA). Office of Conservation and Solar Applications). Sep 1980. Contract AC01-77CS20166. 84p. NTIS, PC A05/MF A01.

A new graphic technique developed to help architects and engineers design more energy-efficient buildings is presented. An energy-efficient design includes two interrelated elements: physical design characteristics which minimize testing, cooling, and lighting loads; and mechanical and electrical subsystems which meet energy loads efficiently. The technique focuses on manipulation of design variables to effectively reduce excessive heat gains and losses. The technique, termed a visual one, is designed to show how a building uses energy. The technique described can also be done manually.

38263 (DOE/CS—0189) **Technology and Consumer Products Branch: program plan.** (Department of Energy, Washington, DC (USA). Office of Buildings and Community Systems). Mar 1980. 45p. NTIS, PC A03/MF A01.

The primary objective of the Technology and Consumer Products Branch (TCP) is to encourage the development and commercialization of energy-efficient technologies and equipment used in buildings and purchased by consumers. The TCP program conducts technical research, development, and demonstration efforts jointly funded with private industry, educational institutions, utilities, and other Federal and state agencies as appropriate. All contracts, grants, or interagency agreements have the major thrust of developing products and disseminating information that will accelerate commercial availability of energy-efficient, low-cost, reliable technologies, techniques, and products suitable for use by consumers and design professionals in the residential and commercial building sectors. Specifically, the technologies pursued by the branch include heating and cooling systems, consumer appliances, lighting design, and systems. Projects for each of these areas are summarized briefly, and publications resulting from the activities are listed.

38264 (DOE/CS/20043—T1) **Development and demonstration of a Stirling/Rankine heat activated heat pump. Semi-annual report, July-December 1979.** (General Electric Co., Philadelphia, PA (USA). Valley Forge Space Center). 1979. Contract AC02-77CS20043. 131p. NTIS, PC A07/MF A01.

A multiphase program for the development of a Gas Heat Pump (GHP) was begun in 1975. The first phase of performance and cost analyses resulted in the selection of the Stirling/Rankine concept as the most promising. The objective of Phase II is to demonstrate that the performance estimates and cost goals of Phase I can be realized. During a previous period of Phase II the components of

the GHP have been designed and fabrication initiated. During this report period effort was concentrated on subsystem fabrication, testing of the combustor, compressor and controls, preparation for integrated engine-compressor testing of the first Proto 2 unit, and updating of system performance and cost analyses. In addition, follow-up test facility upgrading work was completed and the Field Evaluation Test site screening, selection and preliminary modification were carried out. The major system development accomplishments are summarized. Detailed descriptions of the program progress on each subsystem, overall product design and all other related program areas are presented. (LCL)

38265 (DOE/CS/20057—T1) **Bibliography on available computer programs in the general area of heating, refrigerating, air conditioning and ventilating. Final report.** Howell, R.H.; Sauer, H.J. Jr. (Missouri Univ., Rolla (USA)). 24 Jul 1980. Contract AC01-78CS20057. 260p. NTIS, PC A12/MF A01.

This 1980 update of a bibliography first published 1975 lists computer codes for use with heating, ventilation, and air conditioning systems. Each listing in the bibliographies gives the code name, purpose, availability, input requirements, program output, program language, and system compatibility. (LCL)

38266 (DOE/CS/20415—T1) **Aerial measurement of heat loss. Phase 1.** Cuttica, J.; Rizzuto, J. (Calspan Corp., Buffalo, NY (USA)). Jul 1979. Contract AC01-78CS20415. 153p. (NYSERDA—79-10). NTIS, PC A08/MF A01.

Aerial thermography is being used on a large scale to promote energy conservation ostensibly by pointing out structures or parts of structures having high heat loss.

38267 (DOE/TIC—11248) **High seasonal performance factor gas heat pump for the north central United States. Final report.** (Consolidated Natural Gas Service Co., Inc., Cleveland, OH (USA)). Jan 1980. Contract AC02-76CS20041. 202p. NTIS, PC A10/MF A01.

The High Seasonal Performance Factor (HSPF) gas heat pump development and demonstration program involved the technical evaluation, market potential, ownership cost, and system cost analysis of a 7 1/2-ton unit and a Large Size Model (LSM) of 120-ton. Details on the design, performance testing, performance, and economics of the units are presented. The results of this first phase of the program demonstrated that the 7 1/2-ton unit is a technically effective approach to energy conservation for single zone heating and cooling loads, especially where the heating load is dominant, but would have an unacceptably small market due to its high initial cost and life-cycle cost. Results of the first phase of studying the LSM showed high initial cost, high operating cost, low market potential, and little efficiency advantages. Therefore, it was recommended that all technical effort on the LSM program by terminated. (LCL)

38268 (DOE/TIC—11284) **Crawl space-assisted heat pump.** Ternes, M.P. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 10p. NTIS, PC A02/MF A01.

A variety of experiments and simulations have been performed or are being prepared to determine the feasibility of conditioning the source air of an air-to-air heat pump using stored ground heat or cool to produce higher seasonal COP's and net energy savings. Winter data has shown that significant preheating occurs consistently for both the single-pass and total-recycle modes, with the latter showing the better results between the two. Preliminary summer data shows that precooling does occur, but that the heat pump system should be operated in the single-pass mode only. Comparison between experiments has led to the conclusion that the preconditioning is due mostly to the stored earth heat or cool and is not due in any great part to heat exchange with the house. A computer model of the crawl space has been developed, and the development of heat pump models for performance and economic studies is currently underway. Complete data analysis will begin as actual data in digitized form becomes available. Planning for a definitive test addressing the concept's performance and economics has begun.

38269 (LBL—11302) **Two well storage systems for combined heating and airconditioning by groundwater heatpumps in shallow aquifers.** Pelka, W. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1980. Contract W-7405-ENG-48. 81p. NTIS, PC A05/MF A01.

The use of soil and ground water as an energy source and heat storage systems for heat pumps in order to conserve energy in heating and air conditioning buildings is discussed. Information is included on heat pump operation and performance, aquifer characteristics, soil and ground water temperatures, and cooling and heating demands. Mathematical models are used to calculate flow and temperature fields in the aquifer. It is concluded that two well storage systems with ground water heat pumps are desirable, particularly in northern climates. (LCL)

38270 (LBL—11530) **Using DOE-2.1 at Lawrence Berkeley Laboratory.** (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1980. Contract W-7405-ENG-48. 137p. NTIS, PC A07/MF A01.

The manual assists the DOE-2 user in running DOE-2 and its utility programs at LBL. It is organized to reflect the facts that every DOE-2 job run at LBL requires certain steps, and that there are options related to DOE-2 job runs available to any DOE-2 user.

38271 (ORNL/CON—50) **Ice-maker heat pump development. Final report.** Baxter, V.D. (Oak Ridge National Lab., TN (USA)). Sep 1980. Contract W-7405-ENG-26. 71p. NTIS, PC A04/MF A01.

Four test unit ice-maker heat pumps (IMHPs) were tested under the Annual Cycle Energy System (ACES) program. Performance results on the effects of harvesting scheme, plate loading, and cycling operation were compared. The ice-packing density of IMHPs was also studied and compared with that of ice manufactured by commercial ice makers and brine-chiller ACES. Three harvesting schemes were tested: hot-gas, stored-refrigerant, and dual-fluid, off-cycle. The hot-gas scheme tended to penalize excessively the heating output of the system. Stored-refrigerant schemes eliminated that problem but caused compressor failures due to floodback and oil dilution. The dual-fluid schemes exhibited no such problems and demonstrated an ability to harvest during compressor off cycles. Therefore, it was concluded that dual-fluid, off-cycle schemes are the best for use with IMHPs. Plate-loading tests in which compressor speed and evaporator size are varied clearly showed that evaporator plate loading should be as low as possible. Cyclic testing showed that cyclic performance can be improved by using nonequalizing refrigerant systems. Ice-packing density measurements indicated a maximum packing factor for IMHP ice of 0.4 compared with 0.8 for brine-chiller systems. Distributing the ice evenly in water gave better packing factors than did allowing it to pile up under the plates. A survey of commercial ice makers indicated that IMHPs producing cylindrical and cubical ice rather than sheets of ice would have packing factors of 0.8 to 0.66 and thus obvious economic benefits. However, the cost of evaporators for making such ice is not likely to be economical.

RESIDENTIAL BUILDINGS

REFER ALSO TO CITATION(S) 38225

38272 (ANL/SPG—5) **SIMSTOR, a cost-allocation model for assessing electric-heating and -cooling technologies.** Giese, R.F. (Argonne National Lab., IL (USA)). May 1979. Contract W-31-109-ENG-38. 86p. NTIS, PC A05/MF A01.

The simulation code SIMSTOR is an analytical tool that can be used to assess the impact of alternative residential heating and cooling technologies on electric-utility generation, transmission, and distribution systems. Given input information such as plant capacity, forced outage rates, scheduled-maintenance requirements, and economic data for individual generating units, the program uses hourly utility load data together with synoptic weather data to simulate system loads and costs for specified levels of heating- and cooling-technology penetration. Originally designed to study the impact of shifting on-peak demand to off-peak periods through the use of customer-owned thermal storage, the program has been extended to handle a variety of heating and cooling technologies as well as utility-side storage. The program performs five categories of calculations: (1) simulation of residential load, (2) aggregation and propagation of loads through the distribution and transmission subsystems, (3) economic dispatch of generating units, (4) scheduling of plant maintenance, and (5) calculation of economically optimal generating-plant mix. The computer running time for a full set of calculations is short, allowing many system alternatives to be examined at low cost. This report contains a description of the code, a list of input requirements, and the output of a sample run.

38273 (DOE/CS/20314—T1) **Environmental assessment for the Consumer Products Efficiency Standards program.** (Dow Associates, Inc., San Francisco, CA (USA)). 23 May 1980. Contract AC03-79CS20314. 139p. NTIS, PC A07/MF A01.

The Energy Policy and Conservation Act of 1975 as amended by the National Energy Conservation Policy Act of 1978, requires the DOE to prescribe energy efficiency standards for thirteen consumer products. The Consumer Products Efficiency Standards (CPES) program covers the following products: refrigerators and refrigerator-freezers; freezers;clothes dryers;water heaters; room air conditioners; home heating equipment (not including furnaces); kitchen ranges and ovens; central air conditioners (cooling and heat pumps); furnaces; dishwashers; television sets; clothes washers; and humidifiers and dehumidifiers. DOE is proposing two sets of standards for all thirteen consumer products: intermediate standards to become effective in 1981 for the first nine products and in 1982 for the second four products, and final standards to become effective in 1986 and 1987, respectively. The final standards are more restrictive than the intermediate standards and will provide manufacturers with

the maximum time permitted under the Act to plan and develop extensive new lines of efficient consumer products. The final standards proposed by DOE require the maximum improvements in efficiency which are technologically feasible and economically justified, as required by Section 325(c) of EPCA. The thirteen consumer products account for approximately 90% of all the energy consumed in the nation's residences, or more than 20% of the nation's energy needs. Increases in the energy efficiency of these consumer products can help to narrow the gap between the nation's increasing demand for energy and decreasing supplies of domestic oil and natural gas. Improvements in the efficiency of consumer products can thus help to solve the nation's energy crisis.

38274 (DOE/TIC—11275) **Energy and cost analysis of residential heat pumps in northern climates.** Martin, J.K.; O'Neal, D.L. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 6p. NTIS, PC A02/MF A01.

Since 1971, residential heat pump sales have dramatically increased every year. In certain areas of the country, heat pumps account for over 80% of the space heating systems in new housng starts. Penetration in the residential market by heat pumps is beginning to take place in colder areas of the country where heat pumps have traditionally been overlooked. Lack of natural gas and high oil prices, combined with the large energy costs of electric resistance heat have forced renewed attention to the heat pump in colder climates. This paper examines the diversity in heating energy use and cost effectiveness of forty-one currently retailed heat pumps in three northern cities: Boston, Denver, and Minneapolis. Heat pump heating energy use and annualized life-cycle costs are compared with other forms of space heating equipment in those same cities.

38275 (PB—80-135684) **Housing conservation technology: executive summary and recommendations.** Metz, F.E.; Berger, H.W.; Boone, T.H. (National Engineering Lab. (NBS), Washington, DC (USA)). Jul 1977. 45p. NTIS, PC A03/MF A01.

American homeowners often do an inadequate job of conserving their dwellings because they do not know what should be done and because current technologies often cannot be used by do - it - yourselfers. There are also gaps in the technology available for home maintenance and repair. A series of tables evaluate current technology for 11 critical building elements, plus repair and revnovation technology as a whole. These tables summarize the skills needed for use of the technique, the means of installation, and advantages and disadvantages. Topics covered are roofing, exterior cladding, windows, insulation, basement waterproofing, floor and wall underlayments (wet areas), structural framing, heating and cooling systems, plumbing systems, electrical systems, and appliances. Technologies which will enable the homeowner to quickly measure the moisture accumulating under the roof or to evaluate the quality of the home's wiring do not exist; better waterproofing materials are also needed for basements and other wet areas. Little information is available on the durability of various exterior products and window frame security has received little attention. Insulation technology is in a state of flux. Here the homeowner especially needs full information to make an informed decision. Renovation involves special problems because old houses were frequently built out of plumb and settling adds to the problems encountered in using prefabricated materials. Do - it - yourselfers are often the first to use technology; however, conservative lenders and housing codes often hinder such innovation.

38276 (PB—80-135692) **Housing conservation technology.** Metz, F.E.; Berger, H.W.; Boone, T.H. (National Engineering Lab. (NBS), Washington, DC (USA)). Jul 1977. 167p. NTIS, PC A08/MF A01.

Mainly a detailed assessment of the technologies available for dwelling repair, replacement, and renovation, this report focuses on single - family homes and multi - family structures containing up to 20 dwelling units. American homeowners generally handle most repair and maintenance either by doing the work themselves or by calling small contractors for one job at a time. The owner frequently does an inadequate job of conserving the dwelling, not only because maintenance is expensive, but also because current information does not tell what must be done and what the advantages and disadvantages of various technologies are, and does not present the cost data necessary for an informed decision. A state - of - the - art review surveys both the technologies and information available to the homeowner for 11 critical building elements: roofing, exterior cladding, windows, insulation, basement waterproofing, floor and wall underlayments (wet areas), structural framing, heating and cooling systems, plumbing systems, electrical systems, and appliances. Technologies to help the owner handle major jobs such as measuring the amount of moisture under a roof or evaluating house wiring do not exist. In other areas, the technology either has advanced little or is in such a state of flux that data is confusing. Renovation and repair offer additional problems because old houses were often built out of plumb so that settling compounds the problems. A chart lists cost manuals for renovation work. A final section covers the effects of conservative lenders and building codes on innovation. An extensive bibliography is appended.

SCHOOL, MUNICIPAL AND OTHER PUBLIC BUILDINGS

38277 (PB—80-124217) **Analysis of energy use in Minnesota institutional buildings.** Hirst, E. (Minnesota Energy Agency, St. Paul (USA)). Nov 1979. 40p. NTIS, PC A03/MF A01.

This report discusses data collected for the Minnesota Energy Agency on energy use and building characteristics for 1952 buildings owned by public school districts and local government in Minnesota. Information on each building includes year constructed, heated and air conditioned floorspace, occupancy, type of building, annual fossil fuel type(s), use, and costs, and annual electricity use and cost.

COMMERCIAL AND INDUSTRIAL BUILDINGS

38278 (DOE/TIC—11291) **EES small business handbook.** (Department of Energy, Washington, DC (USA). Energy Extension Service). 1980. 71p. NTIS, PC A04/MF A01.

As part of a nationwide effort to reduce dependence on foreign oil and to limit our vulnerability to supply disruptions, Congress enacted the National Energy Extension Service Act in June 1977. This Act authorized an initial 19-month pilot program to be followed by a national program, which was initiated in August 1979. Highlights of the Energy Extension Service (EES) program and the allocation of EES financial assistance for calendar year 1980 are contained in appendix A. All of the ten EES pilot States carried out energy-outreach programs for small business. This Small Business Handbook provides information on developing, organizing, staffing, and managing small-business energy-conservation programs including education, extension, and information activities. The Handbook is intended for use as a guide primarily by new EES States and State Energy Conservation Program (SECP) managers. Although the material in the Handbook is oriented toward energy-related programs for small business, other State users may find the Handbook of value in planning other programs for small businesses. An evaluation of the EES pilot program was initiated in 1977. The resulting report described the first year's activities in 10 Pilot States and reflected which of the 20 emphasis programs work best and why. The Small Business Handbook, building on the portion of the evaluation report dealing with small business and other documentation, addresses the types of management, organization, and implementation techniques that worked best in selected states. The Handbook addresses how these techniques can be employed by others to increase the probability of success when new small-business programs are established.

TRANSPORTATION

LAND AND ROADWAY

REFER ALSO TO CITATION(S) 38320, 38330, 38331, 38337, 38338

38279 (ORNL—5654) **Transportation energy conservation data book: Edition 4.** Kulp, G.; Shonka, D.B.; Collins, M.J.; Murphy, B.J.; Reed, K.J. (Oak Ridge National Lab., TN (USA)). Sep 1980. Contract W-7405-ENG-26. 397p. NTIS, PC A17/MF A01.

This is the fourth edition of the Transportation Energy Conservation Data Book, a statistical compendium compiled and published by ORNL for DOE. Secondary data on transportation characteristics by mode, on transportation energy use, and on other related variables are presented in tabular and/or graphic form. All major modes of transportation are represented: highway, air, rail, marine, and pipeline. The six main chapters focus on various characteristics of the transportation sector including (1) modal characteristics, (2) current energy use, efficiency and conservation, (3) projections of modal energy use, (4) impact of government activities, (5) supply and cost of energy, and (6) general demographic and economic characteristics. Included in the tables and figures are the following transportation stock and use statistics: number of vehicles, vehicle-miles traveled, passenger-miles and freight ton-miles, fleet characteristics, household automobile ownership, size mix of automobiles, vehicle travel characteristics, and commuting patterns. Energy characteristics presented include energy use by fuel source and transportation mode, energy intensity figures by mode, indirect energy use, production as a percent of consumption, imports as a percent of domestic production, energy prices from the wellhead to the retail outlet, and alternative fuels.

38280 (PB—80-128549) **Fuel consumption measurements-carbon balance vs. flow meter. Technical report.** Turton, D. (Environmental Protection Agency, Ann Arbor, MI (USA)). Jul 1979. 10p. NTIS, PC A02/MF A01.

In a recent EPA experiment, fuel consumption data was obtained by both the carbon balance method and the fuel flow method. This report was prepared to describe and compare the two methods of measurements. EPA fuel economy measurements are currently obtained by the carbon balance method. Fuel consumption can also be measured by several other methods such as volumetric,

fuel flow meters, or gravimetric methods. Accurate comparison between methods must be done statistically and requires a large data base. A recent EPA program which investigated the accuracy of the dynamometer simulation of the speed of a vehicle consisted of numerous repetitive steady state dynamometer tests. This program provided an opportunity to obtain sufficient fuel consumption measurements by both methods for the statistical analysis necessary to detect any difference between the methods.

38281 (PB—80-129141) **A track to twin roll dynamometer comparison of several different methods of vehicle velocity simulation. Technical report.** Yurko, J. (Environmental Protection Agency, Ann Arbor, MI (USA)). Jun 1979. 26p. NTIS, PC A03/MF A01.

The current EPA test procedure for fuel economy and emissions testing uses a twin roll dynamometer obtaining a speed signal from the rear roll and simulating the forces at the front roll. With the rolls coupled only by the drive wheels of the vehicle, the front roll travels approximately 2% slower than the rear roll at steady-state 50 mph, resulting in approximately a 4% overprediction of fuel economy. Coupling the rolls externally equalizes the roll speeds at a value which better simulates the road velocity and therefore better predicts the fuel economy. This report describes the test program and data analysis which led to these conclusions.

38282 (PB—80-129844) **Study of the effects of applying Federal Motor Vehicle Safety Standards 203 and 204 to light trucks and vans. Modification No. 3 (final).** McLean, R.F. (DeLorean (John Z.) Corp., Bloomfield Hills, MI (USA). Research and Engineering Div.). 31 May 1979. Contract DOT-HS-7-01770. 36p. NTIS, PC A03/MF A01.

From a careful inspection of trucks, their possible compliance or non-compliance with the requirements of FMVSS 203 and 204 was determined. Where non-compliance was indicated, design studies were made to bring the trucks into compilance. The added weight of the new designs was estimated. Using established cost estimating procedures, the incremental costs of the new design features were estimated. The manufacturing, wholesale, dealer markup, and total consumer costs were estimated. The average service life of the light trucks was used to establish a lifetime fuel cost based on the effects of the weight increases. The industry's leadtime requirements were discussed. Based on 1978 production volumes, the average cost per truck of complying with FMVSS 203 and 204 would be $11.35 per truck.

38283 (PB—80-137953) **Energy policy impact evaluation.** Mufti, R.K.; Munson, M.J.; Chomitz, K.; Margiotta, R.A.; Reilly, L.J. (Transportation Research Board, Washington, DC (USA)). 1979. 44p. NTIS, PC A03/MF A01.

The 5 papers in this report deal with the following areas: approach to assessing the impact of energy conservation policies on transportation demand; survey and analysis of energy intensity estimates for urban transportation modes; foreign oil dependence: state-level analysis; vehicle kilometers traveled: evaluation of existing data sources; and multivariate classification of automobiles by use of an automobile characteristics data base.

38284 (PB—80-127525) **Reducing empty travel by goods vehicles.** Cundill, M.A.; Hull, P.M. (Transport and Road Research Lab., Crowthorne (UK)). [nd]. 34p. NTIS, PC A03/MF A01.

About one-third of all goods vehicle travel is empty. For vehicles over 8.5 tons gross, this apparent wastage amounts to about Pound Sterling 1400M per annum at 1978 operating costs, and contributes significantly to lorry nuisance. The report describes a study of why so much empty running takes place; it contains an analysis of vehicle operations, examines the economics of return loading and attempts to assess how much empty running might be reduced by increased return loading. On the basis of a series of fairly conservative assumptions, it is concluded that modest amounts of empty travel might be saved. For example, increased return loading by platform vehicles could reduce empty travel by vehicles over 8.5 tons gross by 3.5 percent, 150 million vehicle kilometers per annum, giving an annual cost saving of around Pound Sterling 48M (1978) and an annual fuel saving of around 10 million gallons. A number of suggestions are made for increasing the amounts of return loading, based on improved communications between consignors and vehicle operators and the provision of guarantees to protect the parties involved in return loading.

38285 (PB—80-132137) **Fuel utilization of articulated vehicles: effect of gross vehicle weight.** Gyenes, L. (Transport and Road Research Lab., Crowthorne (UK)). [nd]. 32p. NTIS, PC A03/MF A01.

Computer simulation techniques have been used to study the effect of gross vehicle weight and other design and operating factors on fuel consumption and fuel utilization of articulated vehicles. Vehicles were classified by gross vehicle weight and body type. For each class a representative vehicle was selected and its fuel consumption and fuel utilization were calculated over a representative duty cycle. In addition, plausible modifications were made to vehicle and engine design and operating parameters. The effect of these changes was evaluated.

PIPELINE

38286 (DOE/CS/51381—01) **Pipeline bottoming cycle study. Final report.** (General Electric Co., Cincinnati, OH (USA)). Jun 1980. Contract AC03-77CS51381. 259p. NTIS, PC A12/MF A01.

The technical and economic feasibility of applying bottoming cycles to the prime movers that drive the compressors of natural gas pipelines was studied. These bottoming cycles convert some of the waste heat from the exhaust gas of the prime movers into shaft power and conserve gas. Three typical compressor station sites were selected, each on a different pipeline. Although the prime movers were different, they were similar enough in exhaust gas flow rate and temperature that a single bottoming cycle system could be designed, with some modifications, for all three sites. Preliminary design included selection of the bottoming cycle working fluid, optimization of the cycle, and design of the components, such as turbine, vapor generator and condensers. Installation drawings were made and hardware and installation costs were estimated. The results of the economic assessment of retrofitting bottoming cycle systems on the three selected sites indicated that profitability was strongly dependent upon the site-specific installation costs, how the energy was used and the yearly utilization of the apparatus. The study indicated that the bottoming cycles are a competitive investment alternative for certain applications for the pipeline industry. Bottoming cycles are technically feasible. It was concluded that proper design and operating practices would reduce the environmental and safety hazards to acceptable levels. The amount of gas that could be saved through the year 2000 by the adoption of bottoming cycles for two different supply projections was estimated as from 0.296 trillion ft^3 for a low supply projection to 0.734 trillion ft^3 for a high supply projection. The potential market for bottoming cycle equipment for the two supply projections varied from 170 to 500 units of varying size. Finally, a demonstration program plan was developed.

INDUSTRY AND AGRICULTURE

REFER ALSO TO CITATION(S) 38221

ENERGY SOURCES

38287 (BNL—51197) **Measures to reduce industrial consumption of petroleum under a short-term energy emergency.** Tessmer, R.G. Jr; D'Acierno, J.; Pilati, D.A. (Brookhaven National Lab., Upton, NY (USA). National Center for Analysis of Energy Systems). Feb 1979. Contract AC03-76CH00016. 25p. NTIS, PC A02/MF A01.

Significant opportunities for petroleum conservation in the industrial sector in the event of an energy emergency are discussed. The most feasible government options identified are presented. These and the probable savings are: removing institutional barriers to fuel switching in industrial boilers and burners (384 to 407 Mbbl/day); rescinding certain air pollution regulations (19 to 100 Mbbl/day); restricting export of energy-intensive goods (20 to 60 Mbbl/day); rescinding thermal pollution regulations for power plants (16 to 27 Mbbl/day); removing trade barriers on certain imports; restricting electricity production by industry; and restricting export of recyclable materials. The bases for many of the recommended options are presented. Specifically, characteristics of industrial petroleum consumption for the chemical, steel, cement, and paper industries are presented.

38288 (PB—80-124936) **The electricity supply network in England and Wales and electric metal melting.** Langman, R.D. (Electricity Council Research Centre, Capenhurst (UK)). Aug 1978. 31p. NTIS, PC A03/MF A01.

Melting loads are not geographically distributed in an even manner and the supply system needs to accommodate these concentrated loads in a way which does not cause problems to other consumers of electricity. The UK supply system is described briefly and the various forms which melting furnaces can take are also discussed. The melting process used on a furnace type could influence the electrical behavior of a furnace on to the system. The paper reviews the interaction of furnace configuration, melting process and supply network, highlighting those aspects which relate to the disturbances caused by melting units. The way in which such disturbances arise is introduced, justifying the need for engineering recommendations relating to the connection of melting furnaces to the network.

38289 (SAND—79-8290) **Potential for conserving oil and natural gas used in industry.** Pohl, J.H. (Sandia Labs., Albuquerque, NM (USA)). Sep 1980. Contract AC04-76DP00789. 22p. NTIS, PC A02/MF A01.

The industrial use of natural gas and oil in the United States is summarized, and the potential for conservation of these fuels through improved efficiency and conversion to the use of coal and waste fuels is estimated. A cooperative program involving all the major industrial users and DOE could result in the energy savings of 960 million barrels of oil equivalent per year by the year 2000. Such a program should incorporate European and Japanese experience through the offices of the IEA. An effective means for coordinating an industrial conservation effort of the proposed scale would be to involve the American Flame Research Committee at an early stage in the planning effort.

EQUIPMENT AND PROCESSES

38290 (CONF-751275—1) **Advantages in energy, fuel, and investment savings by melt-type granulation processes.** Young, R.D.; Lee, R.G. (Tennessee Valley Authority, Muscle Shoals, AL (USA). Div. of Chemical Development). 1975. 31p. NTIS, PC A03/MF A01.

From Technical conference of International Superphosphate and Compound Manufacturers Association Limited and the Fertilizer Association of India; New Delhi, India (8 Dec 1975).

Melt-type processes developed by TVA, in which wet-process phosphoric acid provides all or most of the P_2O_5 in granular fertilizers, show promise in decreasing fuel, total energy, investment, and operating cost. The analyses and estimates were based on pilot-plant studies and demonstration-plant experience at TVA's National Fertilizer Development Center, Muscle Shoals, Alabama. It is shown that elimination of fuel for drying and substantially decreased horsepower requirements (particularly in a new plant) would decrease energy requirement in the granulation plant by about 1,000,000 Btu's per metric ton of P_2O%. When coupled with lower operating costs that are based on investment factors, the savings for the granulation plant is indicated to be about $6 per metric ton of P_2O_5 for a melt-type ammonium phosphate plant. As explained in the text, there would be just about a tradeoff in energy required for drying in a conventional ammonium phosphate granulation plant (where wet-process acid also is produced) against the equivalent steam that would be needed to concentrate the feed acid from 40% P_2O_5 to 52 to 54% P_2O_5 for use in melt-type granulation. This would decrease the overall estimated savings for a melt-type ammonium phosphate granulation plant to about $3.65 per metric ton P_2O_5. In the case of NPK granulation plants using 52 to 54% P_2O_5 acid shipped in, the full indicated savings of about $5.10 per metric ton nutrient should be realized. Savings in existing and new plants are indicated.

38291 (CONF-800769—1) **Fertilizers, energy, and opportunities for conservation.** Davis, C.H.; Blouin, G.M. (Tennessee Valley Authority, Muscle Shoals, AL (USA). Div. of Chemical Development). 1980. 20p. NTIS, PC A02/MF A01.

From Southwestern fertilizer conference; Houston, TX, USA (17 Jul 1980).

Fertilizers account for about 25% of the energy used in our agricultural system through the point of harvesting the crop (about 4% of the total energy consumed). The big fertilizer energy input is ammonia production, which accounts for nearly 70% of the total. The other main items are storage, transport, and handling of the product (accounting for 11%) and phosphoric acid production which accounts for about 7%. In the industry, essentially all of the nitrogen comes from ammonia. There is a need for US industry to examine prospects for making ammonia from coal since we have large reserves of coal and are using natural gas supplies faster than it is being found in the US. Anticipated new developments in electric power generation, such as off-peak power from nuclear plants, coal-based MHD, and OTEC, are causing increased interest in electrolysis of water to make hydrogen for ammonia. Companies are working on electrolyzers that are expected to be much more energy efficient than those operating today. Solar energy in ammonia production has been examined. A major opportunity for energy conservation of nitrogen fertilizers is in improving the crop uptake efficiency after it is applied. Possible routes reported under study for improving nitrogen efficiency include developing new and improved products, improved application technology, and better farm management practices.

38292 (DOE/CS/40061—7) **Use of precalciners to remove alkali from raw materials in the cement industry. Final report, July 1978-July 1980.** Gartner, E.M. (Portland Cement Association, Skokie, IL (USA)). Jul 1980. Contract AC02-78CS40061. 185p. NTIS, PC A09/MF A01.

The objective of this work was to develop an efficient means of removing alkali metal compounds (alkalies) from high-alkali aluminosilicate raw materials of the type commonly used as part of cement raw mixes in order to increase the energy efficiency of cement manufacture. The intention of this project was to determine whether the high-alkali raw materials could be pyroprocessed separately to remove the alkalies before they entered the rotary kiln, where they would be mixed with the other raw feed components. If this could be achieved, considerable savings could be made in the energy required to remove alkalies, compared to conventional methods in which the cement raw mix must be treated as a whole. Two different methods of alkali removal were examined, namely, vaporization of alkalies at relatively low temperatures; and alkali-rich melt separation at relativey high temperatures. The results showed that the removal of alkalies by pyroprocessing of high-alkali raw feed components separate from the other cement raw mix components is not likely to be a practical alternative to the best available conventional precalciner technology. (LCL)

38293 (ORNL/MIT—311) **Analysis of energy conservation potential for distillation processes in the petrochemical industry.** Ngan, F.; Hung, T.D. (Massachusetts Inst. of Tech., Oak Ridge, TN (USA). School of Chemical Engineering Practice; Oak Ridge National Lab., TN (USA)). Oct 1980. Contract W-7405-ENG-26. 62p. NTIS, PC A04/MF A01.

Empirical models were developed for determining energy conservation potential in distillation processes through optimizing the number of trays, control retrofit, and insulation retrofit. An exponential technology parameter, which related capital and energy costs, was determined for each case. The models developed were then applied to the overall cost-energy dynamics analysis to determine the cost and energy optima. The thermodynamic minimum energy requirements were also evaluated for several binary separations.

38294 (ORNL/TM—7355) **Optical watthour meter digitizer.** Andrews, W.H. (Oak Ridge National Lab., TN (USA)). Oct 1980. Contract W-7405-ENG-26. 18p. NTIS, PC A02/MF A01.

As concern about energy conservation and energy-use efficiency increases, a simple and inexpensive instrument that would provide accurate, reliable and high-resolution data on electrical energy usage should find widespread application in research and industrial facilities. An instrument that would also provide one or more outputs compatible with a wide range of digital data acquisition systems would be especially appropriate, since the use of automatic data logging equipment is now common, even in small-scale and low-budget operations. An optical watthour meter digitizer was developed which meets these criteria. Based on the induction-type watthour meter, the digitizer provides an output pulse for a fixed amount of energy use. The digitizer senses the motion of the rotor disc of the meter by optically detecting passage of a nonreflective area painted on the underside of the disc. The passage of such area initiates a logic-compatible output pulse that can be used to measure power or energy usage in a variety of ways. The accuracy of the measurement is determined by the watthour meter. The resolution of the measurement is determined by the K/sub h/ constant (in watthours per revolution) of the meter and the number of equally spaced targets painted on the disc. The resolution of this device can be as small as a fraction of a watthour; the resolution of the manually read register on a watthour meter is typically a fraction of a kilowatthour. Several digitizers were fabricated, bench-tested, and installed in the field for long-term performance testing. All are performing satisfactorily.

38295 (PB—80-126360) **An equilibrium analysis of selected intercity freight markets: trucks with double trailers vs. TOFC (trailer on flatcar) shuttle trains as energy conservation alternatives. Final report Jun-Dec 77.** Roberts, P.O.; Brigham, T.B.; Miller, C.A. (Massachusetts Inst. of Tech., Cambridge (USA). Center for Transportation Studies). Dec 1977. 115p. NTIS, PC A06/MF A01.

The objective of the research is to determine the transportation market consequences in an environment in which two competitive modes, TOFC shuttle trains and double-trailer trucks, are allowed to compete freely. The analysis requires looking at both the demand and the supply side. A model of the decisions made by individual managers responsible for logistics is used on the demand side. For each firm, it is possible to hypothesize a logistics cost for maintaining an inventory of each of the inputs used in the production process. Such a logistics cost function contains elements for placing an order, transporting the goods, distributing and storing them, paying interest on the money invested, and incurring such costs as would accrue with a stockout of these goods. The logistics cost function is minimized through simulating the manipulations of the decision-maker of certain choice variables. These include the location of point of purchase or acquisition of the product, the decision on when to reorder and in what size of shipment, and finally, the mode to be used for the transport. This model of demands by individual decision-makers is used to analyze a sample of the population of shippers within three major city-pair markets for the year 1967: Philadelphia-Cleveland, San Francisco-Los Angeles, and Chicago-Houston. The decisions of the individual decision-makers are aggregated for each of the policy options under consideration, and a comparison is performed with the base case for each market. The results give an indication of the shipper response to each of the options. Fuel use implications of each of the policy options is developed.

38296 (PB—80-129513) **Evaluation of the small farm energy project at the Center for Rural Affairs.** Burrill, G.; Nolfi, J.; Haupt, R. (Rural Development, Inc., Burlington, VT (USA)). 1 Dec 1979. Contract CSA-P-78-30. 91p. NTIS, PC A05/MF A01.

This is an evaluation of the Small Farm Energy Project which is located in a rural county in northeastern Nebraska. The Project demonstrates how low-income farm families can achieve energy self-sufficiency through techniques such as conservation, weatherization and solar technologies, thereby affecting an increase in farm net income.

38297 (PB—80-803539) **Energy conservation and savings in the food industry (citations from Food Science and Technology Abstracts). Report for Jan 1972-Nov 1979.** Hippler, R.R. (New England Research Application Center, Storrs, CT (USA)). Feb 1980. 102p. NTIS PC N01/MF N01.

The citations cover world-wide literature on conservation and savings in energy use for the food industry. Industries covered are dairies (including milk, cheese, cream, ice cream), breweries, meat industry, food processing plants, food warehouses, bakeries, and sugar factories. Energy savings aspects are alternate energy forms, solar drying and dehydration (including for grains and fruits), energy recycling (waste energy usage), and use of by-products for energy, such as biogas. The articles cover techniques equipment, and design for energy conservation. (Contains 95 abstracts)

WASTE HEAT RECOVERY AND UTILIZATION

REFER ALSO TO CITATION(S) 38286

38298 (PB—80-133986) **An aquaculture pilot plant for lobsters.** Turner, L.S.; Zahradnik, J.W.; Terry, O.W. (State Univ. of New York, Stony Brook (USA). Marine Sciences Research Center). 1979. 82p. NTIS, PC A05/MF A01.

A major component of the proposed lobster-culture facility is heated waste water from a power plant. The warm water makes production feasible by speeding lobster maturation. This facility also cultures seaweeds that supply valuable products for food and pharmaceutical industries. Plans for the facility are described in detail. This study analyzes a marine aquaculture complex to operate in conjunction with the Long Island Lighting Company (LILCO) nuclear power plant at Shoreham, New York.

INDUSTRIAL WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 37512, 37532, 37533, 37546, 37795, 37796, 37847, 38485, 38806

38299 (EPA—600/7-79-167b, pp 1187-1203) **By-product-utilization/ultimate: disposal of gas cleaning wastes from coal-fired power generation.** Ellison, W. (NUS Corp., Rockville, MD); Shapiro, E. Jul 1979.

From 5. flue gas desulfurization symposium; Las Vegas, NV, USA (5 Mar 1979).

A review is given of pollution control rules in solids disposal called for by Public Law 94-580, The Resource Conservation and Recovery Act of 1976, and now formally proposed by EPA. The text of these requirements indicates that the disposal of solid collected and formed in cleaning of flue gas from coal-fired boilers can be expected to be subject to comprehensive environmental regulations governing design, permitting and operation of storage and disposal sites. Levels of concentration of heavy trace elements in fired coal will directly influence hazardousness in disposal of both fly ash and scrubber sludge, as well as the complexity of controls required for groundwater protection. A review of recently published details of EPA stir-testing procedures and toxicity data on mixtures of wet-collected fly ash and scrubber sludge indicates that fly ash and SO_2 solids may be expected to regularly test out as non-hazardous. At the same time, isolated disposal and broad availability of current and future fly ash production for by-product utilization may be significantly limited. This is the reslt of anticipated increasing use of dry fly ash catch as a fixation reagent to stablize SO_2 sludge for improved ultimate disposal. Major site-related hydrological and geological factors affecting selection, design and operation of sites for permanent disposal of raw and stabilized solid wastes are reviewed along with techniques for preliminary investigation of acceptability of existing facilities and available sites. Utilization of fly ash and pyrites wastes in flue gas desulfurization (FGD), and emerging of commercial design technology for broadened application of coal-based regenerative FGD technology is described along with interrelated progress in management of coal cleaning waste.

38300 (EPRI-FP—1207(Vol.4)) **Disposal of polychlorinated biphenyls (PCBs) and PCB-contaminated materials. Volume 4. Test incineration of electrical capacitors containing PCBs. Final report.** Flynn, N.W.; Wolbach, C.D. (Acurex Corp., Mountain View, CA (USA). Energy and Environmental Div.). Sep 1980. 152p. NTIS, PC A08/MF A01.

This report presents the results of a trial burn conducted at the Energy Systems Company (ENSCO) located in El Dorado, Arkansas in order to determine whether liquid PCBs and shredded electronic capacitors could be incinerated in accordance with the recent EPA rules and regulations published in the Federal Register (40 CFR Part 761, Vol. 44, No. 106, pp. 31513-31568, May 31, 1979). Based on the results of this trial burn, PCBs were not detected in the stack effluent, the scrubber liquor effluent, or the recycled scrubber liquor from the sludge lagoon. PCBs were detected in the ash effluent from the rotary kiln and were less than 550 ppM, the lower limit at which PCBs are regulated by the EPA. A discussion is given of problems associated with the EPA perchlorination procedure for analyzing PCBs.

38301 (PB—80-140528) **Quantification of municipal disposal methods for industrially generated hazardous wastes. Final report, 1978-1979.** VanNoordwyk, H.; Schalit, L.; Wyss, W.; Atkins, H. (Acurex Corp., Mountain View, CA (USA). Energy and Environmental Div.). Aug 1979. Contract EPA-68-02-2567. 76p. NTIS, PC A05/MF A01.

Estimations of the amounts of industrial hazardous wastes being disposed of according to various methods of disposal were generated for significant portions of the five following SIC codes: 28, Chemical and Allied Products; 29, Petroleum Refining and Related Industries; 30, Rubber and Miscellaneous Plastic Products; 31, Leather and Leather Products; 36, Electrical and Electronic Machinery, Equipment, and Supplies. The portions studied account for approximately half of the industrial hazardous waste disposed of in this country.

38302 (RFP-Trans—284) **Ferrite process for treatment of wastewater containing heavy metals.** Iguchi, T.; Kamura, T.; Inoue, M. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). May 1980. Translation of PPM—1979/4, pp 49-56. 17p. NTIS, PC A02/MF A01.

The ferrite process as a unique process in the field of wastewater treatment technology is introduced, and the stabilization treatment of electrostatic precipitator (EP) ash generated from municipal incinerators using this process is discussed. Information is presented on the properties of ferrites, the distribution and concentration of heavy metals in and the solubility of EP ash, heavy metal leaching, an EP ash treatment device, and the money savings possible by using the ferrite process as compared with other stabilization methods. (LCL)

38303 **Proceedings of the 32nd industrial waste conference.** Ann Arbor, MI; Ann Arbor Science Publishers, Inc. (1978). 1120p. (CONF-7705185—).

From 32. industrial waste conference; Lafayette, IN, USA (10 May 1977).

Separate abstracts were prepared for 28 of the 101 papers on industrial waste management.

MUNICIPALITIES AND COMMUNITY SYSTEMS

REFER ALSO TO CITATION(S) 38252

38304 (BNL—51213) **Energy conservation in two northeastern cities: opportunities, problems, and prospects.** Bryant, F.C.; Moskowitz, P.D. (Brookhaven National Lab., Upton, NY (USA). National Center for Analysis of Energy Systems). Oct 1979. Contract AC02-76CH00016. 45p. NTIS, PC A03/MF A01.

Policy assessment of energy conservation strategies has tended to emphasize technological and economic costs, problems, and benefits. However, too narrow a focus may fail to delineate all the environmental and social impacts associated with the technology in question. In recognition of the importance of a balanced evaluation, a study was undertaken to identify local-level perceptions about environmental and social problems and opportunities associated with several energy conservation measures. These measures included building performance standards and retrofit; waste heat utilization; modifications in land use configurations and transportation modes; and electric utility demand management, and rate reform initiatives. The perceptions were identified by interviewing 55 officials, planners, and members of business and citizen groups in Erie, Philadelphia, and Harrisburg (the capital), Pennsylvania. Results of the study indicate that implementation of the energy conservation measures under investigation faces political, economic, and social barriers of varying dimensions. Major among these are the constraints felt to be imposed by a declining economy and the resulting concern with attracting and holding business and industry.

38305 (CONF-8003107—1) **Domed community and several alternatives for Winooski, Vermont: the environmental, organizational, and energy conservation issues.** Wendt, R.L. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 24p. NTIS, PC A02/MF A01.

From International dome symposium; Winooski, VT, USA (27 Mar 1980).

The environmental, organizational, and energy conservation issues related to a domed structure enveloping Winooski, Vermont, are discussed. Alternative means of accomplishing energy conservation will be addressed. These include retrofitting of existing structures, replacement with state-of-the-art structures, the use of planting shelter-belts, redevelopment to an earth-sheltered community, and redevelopment to a composite domed neighborhood and earth-sheltered community. The assets and liabilities of each alternative are addressed.

38306 (COO—4976-1(Vol.2)) **District heating and cooling systems for communities through power plant retrofit and distribution network, city of Piqua, Ohio.** (Georgia Inst. of Tech., Atlanta (USA). Engineering Experiment Station). 1979. Contract EM-78-C-02-4976. 509p. NTIS, PC A24/MF A01.

The feasibility analysis and evaluation of the Piqua, Ohio District Heating and Cooling Demonstration program is being conducted by the Piqua Municipal Power Co., the Piqua Law Dept., the Public Works Dept., a firm of economic analysts, and the Georgia Tech Engineering Dept. This volume contains information on the organization and composition of the demonstration team; characterization of the Piqua community; and the technical, environmental, institutional; financial, and economic assessments of the project. (LCL)

38307 (DOE/CS/20349—1) **Energy conserving site design case study: Shenandoah, Georgia. Final report.** (Shenandoah Development, Inc., GA (USA)). Jan 1980. Contract AC01-78CS20349. 389p. NTIS, PC A17/MF A01.

The case study examines the means by which energy conservation can be achieved at an aggregate community level by using proper planning and analytical techniques for a new town, Shenandoah, Georgia, located twenty-five miles southwest of Atlanta's Hartsfield International Airport. A potentially implementable energy conservation community plan is achieved by a study team examining the land use options, siting characteristics of each building type, alternate infrastructure plans, possible decentralized energy options, and central utility schemes to determine how community energy conservation can be achieved by use of pre-construction planning. The concept for the development of mixed land uses as a passively sited, energy conserving community is based on a plan (Level 1 Plan) that uses the natural site characteristics, maximizes on passive energy siting requirement, and allows flexibility for the changing needs of the developers. The Level 2 Plan is identical with Level 1 plan plus a series of decentraized systems that have been added to the residential units: the single-family detached, the apartments, and the townhouses. Level 3 Plan is similar to the Level 1 Plan except that higher density dwellings have been moved to areas adjacent to central site. The total energy savings for each plan relative to the conventional plan are indicated. (MCW)

38308 (PB—80-135619) **Indio, California energy conservation project. Final report.** Hunt, M.; Bainbridge, D.; Maeda, B.; Hammond, J.; Kopper, B. (Living Systems, Winters, CA (USA)). 16 Mar 1977. 141p. NTIS, PC A07/MF A01.

The City of Indio, Calif., developed a local energy conservation program to demonstrate the type of planning and implementation practical for cities with populations under 20,000. The project staff began by collecting data, reviewing building codes, analyzing the climate, and analyzing the environmental impact of both current and proposed planning and building practices. This review revealed that current building codes actually discourage energy conservation. These codes mandate unusable side yard space, large ornamental front yards, and fairly small back yards which taken together (1) encourage sprawl and increase the area covered with pavement heat problems; (2) increase the distance residents must travel, discouraging walking; and (3) remove land from agricultural use. Commercial codes paid little attention to the use of overhangs and techniques to reduce heat retention. Safe walkways and bicycle paths were not routinely considered in planning. Commercial buildings were generally overlit, with city - owned buildings the worst offenders. Since Indio's climate is predominantly hot and dry, most of the suggestions focus on ways to cut air conditioning costs, although many of the techniques would also cut heating costs. Diagrams show how landscaping, overhangs, and window design reduce heat gain. Building materials are evaluated and various residential and commercial design changes are illustrated. An energy - saving checklist is included as are tabular data, technical appendices, and a bibliography.

38309 (SERI/CP—354-421) **Community energy self-reliance.** (Solar Energy Research Inst., Golden, CO (USA)). Jul 1980. Contract AC02-77CH00178. 568p. (CONF-790864—). NTIS, PC A24/MF A01.

From Community renewable energy systems conference; Boulder, CO, USA (20 Aug 1979).

The proceedings of a workshop/conference on Community Renewable Energy Systems are presented. This meeting was sponsored by DOE and SERI to encourage decentralization in attacking energy problems, to show how renewable energy can meet community goals, to present examples of successful projects, to discuss the planning and management of renewable energy systems, to identify sources of financial support, to share legal strategies, and to examine utility roles. Presented papers and workshop summaries are included. (WHK)

PUBLIC UTILITIES

REFER ALSO TO CITATION(S) 38073

38310 (ANL/ICES-TM—6) **Factors that influence the acceptance of integrated community energy systems.** Kennedy, A.S.; Tschanz, J.F. (Argonne National Lab., IL (USA); Chicago Univ., IL (USA)). Jan 1978. Contract W-31-109-ENG-38. 244p. NTIS, PC A11/MF A01.

A study designed to analyze the commercialization potential of various concepts of community-scale energy systems termed ICES is presented. Ways that affected individuals and organizations will respond to proposed ICES development projects are specifically examined. In Section 2, the process that is typically followed in producing a large-scale development is outlined as a means of revealing some of the ways that institutional sectors impinge on the developer. From this general overview, Section 3 elaborates on the examination of three of the institutional sectors - public institutions, private institutions, and consumers. A fourth sector - financial institutions - is the subject of aother project whose results are reported separately. The research surveys supporting Section 3 provide basic descriptions of the organizations of the sectors and the roles played in the development process. Fullscale community systems development scenarios were not available for simulating institutional responses. However, some present types of development (notably planned unit developments) have features that might be important for energy conservation. Known responses to these developments have been used to infer potential factors affecting community systems proposals.

38311 (EPRI-EM—1531) **Industrial cogeneration case studies. Final report.** Limaye, D.R.; Isser, S.; Hinkle, B.; Friedman, N.R. (Synergic Resources Corp., Bala-Cynwyd, PA (USA)). Sep 1980. 129p. NTIS, PC A07/MF A01.

Studies were performed on a number of operating cogeneration systems to determine application, economics, and attitudes of industrial and utility executives toward cogeneration. The study was carried out in four tasks. In Task I, a literature survey was conducted and an identification of candidate cogeneration sites was carried out. This was followed by a screening of these sites down to 20 to 30 candidate sites. The screening was carried out on the basis of cogeneration capacity, geographical diversity, generation type, and industrial diversity. In Task II, the remaining sites were contacted as to their willingness to work with EPRI, and an industrial questionnaire was developed on technical, economic, and institutional cogeneration issues. Each of the seventeen sites was visited during this task. In Task III, the site information was completed and tabulated. In Task IV, a utility questionnaire was developed and utilities with cogeneration systems studied in this survey, in their service territory, were contacted as to their attitudes toward cogeneration. In addition, a compilation of a list of operating cogeneration systems was performed during this task.

38312 (ORNL/TM—6830/P9) **District heating/cogeneration application studies for the Minneapolis-St. Paul area. Modfifications of the existing units at the High Bridge Power Plant to cogeneration for hot water district heating.** Englesson, G.A.; Casapis, M.C.; Pavlenco, G.F.; Menaker, B.; Lee, N.H.; Denesdi, L.; Williamson, D.E. (Oak Ridge National Lab., TN (USA)). Oct 1980. Contract W-7405-ENG-26. 148p. NTIS, PC A07/MF A01.

The electrical generating turbines at the High Bridge Generating Station were evaluated for their suitability for conversion to cogeneration. This evaluation required examinations of the equipment, the operating reports, and the technical manuals and drawings. The evaluation also included discussions with the plant staff and with the major vendors of the operating equipment. Units 3, 5, and 6 were recommended for conversion to cogeneration-unit 3 to be converted to back-pressure operation and units 5 and 6 to be converted to condensing-tail operation. Unit 4 was not recommended for conversion.

MUNICIPAL WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 37792

38313 (CONF-791072—5) **Energy conservation and scale-up studies for a wastewater treatment system based on a fixed-film, anaerobic bioreactor.** Genung, R.K.; Pitt, W.W. Jr.; Davis, G.M.;

Koon, J.H. (Oak Ridge National Lab., TN (USA); Associated Water and Air Resources Engineers, Inc., Nashville, TN (USA)). 1979. Contract W-7405-ENG-26. 39p. NTIS, PC A04/MF A01.

From 2. symposium on biotechnology in energy production and conservation; Gatlinburg, TN, USA (3 Oct 1979).

Oak Ridge National Laboratory (ORNL) is developing an energy-conserving wastewater treatment system based on a fixed-film anaerobic bioreactor. The treatment process is based on passing wastewaters upward through the bioreactor for continuous treatment by gravitational settling, biophysical filtration, and biological decomposition. A 2-year pilot plant project using a bioreactor designed to treat 5000 gallons per day (gpd) has been conducted using raw wastewater on a municipal site in Oak Ridge, Tennessee. From analyses of data obtained for the performance of this bioreactor it was estimated that hydraulic loading rates of 0.2 gpm/ft^2 and hydraulic residence times of 10 hr could be used in designing such bioreactors for the secondary treatment of municipal wastewaters. Conceptual designs for total treatment systems processing up to 1.0 million gallons of wastewater per day (mgd of wastewater) were developed. These systems were compared to activated sludge treatment systems also operating under secondary treatment requirements and were found to consume as little as 30% of the energy required by the activated sludge systems. The economic advantages of the process result from the elimination of operating energy requirements associated with the aeration of aerobic-based processes and with the significant decrease of sludge-handling costs required with conventional activated-sludge treatment systems. Methane produced by anaerobic fermentation processes occurring during the biological decomposition of carbonaceous wastes also represented a significant and recoverable energy production term as wastewater flow rates approached 1.0 mgd. A 50,000-gpd wastewater treatment system is being developed for demonstration purposes.

38314 (DSE—5580-T1) **Urban Waste Conversion Systems. IGT Project 61030 final report, October 1, 1978-March 31, 1979.** Cowen, D.S.; Daniels, E.J.; Novil, M. (Institute of Gas Technology, Chicago, IL (USA)). Feb 1980. Contract EI-78-X-01-5580. 72p. NTIS, PC A04/MF A01.

The purpose of this study was to assess the market potential of the various systems available, or under development, for converting urban wastes into synthetic gas or liquids. The primary data base for this assessment is a survey which IGT has sent out to experts in this field. The experts were asked to evaluate various conversion systems by assigning point totals to an evaluation matrix. They were also asked to summarize their work in urban waste conversion, to list critical paths which represent obstacles to be surmounted by R & D, and to assess the effect of those obstacles on the market potential of that process. Critical areas for R & D work focus on materials handling and separation techniques, and protection of equipment from abrasive, caustic, or corrosive chemicals in the wastes. Also, prohibitive capital and operating costs in some existing systems must be cited, since investor confidence is eroded by evidence of such experiences. Downtime has been excessive with many systems, stemming from feed problems brought on by the heterogeneous nature of the feedstock. Systems using homogeneous feeds have shown considerably less problems. Perhaps a critical area from a social impact point of view is, can garbage separation be instituted for the home, factory, etc. If so, the chances for waste converison systems to overcome technical problems on the front end are greatly improved, and so is the potential for market penetration.

38315 Method for determining processible waste for a resource recovery facility. Bider, W.L.; Franklin, W.E. (Franklin Assoc Ltd, Prairie Village, Kans). pp 211-219 of National waste process conference. New York, NY; American Society of Mechanical Engineers (1980).

From 9. biennial national waste process conference; Washington, DC, USA (11 May 1980).

Accurate estimates of available waste are of vital importance to the design of an efficient and economical resource recovery facility. In work for the Department of Energy, Franklin Associates, Ltd. has developed and successfully tested a technique to estimate collected municipal solid waste based upon readily available socio-economic and demographic data. Details of the technique are discussed, including seasonal effects and caveats to assist planners/designers in determining waste supply. 10 refs.

38316 Anaerobic wastewater treatment in a two-stage reactor of a new design. Norrman, J.; Frostell, B. (Swedish Water and Air Pollution Research Lab., Stockholm). pp 387-401 of Proceedings of the 32nd industrial waste conference. Ann Arbor, MI; Ann Arbor Science Publishers, Inc. (1978).

From 32. industrial waste conference; Lafayette, IN, USA (10 May 1977).

One year of operation and performance testing of a two-stage FRONO- reactor which combines the contact process and an anaerobic filter for treating sewage are discussed. The energy aspects of biological wastewater treatment were analyzed. The analysis indicates that from an energy standpoint anaerobic treatment is profitable whenever the BOD value of the incoming wastewater exceeds 1000 to 1500 mg/l. A substantial net energy yield can be achieved when concentrated wastewaters are treated anaerobically. A cost analysis was made comparing aerobic wastewater treatment and the results from the FRONO-reactor. The annual treatment costs were calculated as a function of the BOD value of the incoming wastewater within the range 500 to 3500 mg/l. It was found that wastewaters with a BOD value of more than 1000 to 1500 mg/l ought to be treated anaerobically. Considerable cost savings are possible for more concentrated wastewaters. (LCL)

EDUCATION AND PUBLIC RELATIONS

REFER ALSO TO CITATION(S) 38251

38317 (ORAU—164) **DOE faculty development program: an evaluation.** Garey, R.B. (Oak Ridge Associated Universities, Inc., TN (USA). Manpower Education, Research and Training Div.). Sep 1980. Contract AC05-76OR00033. 46p. NTIS, PC A03/MF A01.

The purpose of this study is to evaluate the effectiveness of the Faculty Development Program in (1) communicating energy information to junior high, high school, and university teacher during summer workshops; and (2) motivating these teachers to incorporate the newly acquired knowledge about energy concepts and methods of instruction in their classrooms. To assess the extent to which these program objectives have been achieved, separate surveys of 1978 and 1979 participants were conducted. The 1979 participants were asked to describe the quality of the workshops and their intent to introduce the energy concepts into their classrooms. A sample of participants in the 1978 workshops, and a national sample of high school science teachers used as a comparison group, were asked to respond to a follow-up survey aimed at determining the effects of the program. The results of these surveys are discussed.

ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

INTERNAL COMBUSTION ENGINES

SPARK-IGNITION

REFER ALSO TO CITATION(S) 38347

38318 Raman spectroscopy and flow visualization study of stratified charge engine combustion. Johnston, S.C. (Sandia Lab, Livermore, Calif). *SAE Prepr.;* No. 800136, vp(1980).

Transient, precombustion fuel/air ratios at the spark plug electrode gap in a direct injection stratified charge engine have been measured using cw laser Raman spectroscopy and have been correlated with mixture ignitability measurements. Flow visualization of the stratified charge combustion revealed substantial differences in mixture burn characteristics and combustion duration as the ignition crank angle was varied. Quenching of the burning mixture was observed and its occurrence was correlated with the Raman measurements. 13 refs.

38319 Parametric studies of fuel consumption and no emissions of dilute spark-ignition engine operation using a cycle simulation. Heywood, J.B.; Watts, P.A. (MIT, Cambridge, Mass). pp 117-127 of Fuel econ and emiss of lean burn engines. London, England; Mechanical Engineers Publ. Ltd (1979).

From Fuel economy and emissions of lean burn engines conference; London, UK (12 Jun 1979).

A computer simulation of the four-stroke spark-ignition engine cycle for studies of the effects of variations in engine design and operating parameters on engine performance, efficiency and NO emissions is described. The simulation predicts mass flow rates through the intake and exhaust valves, cylinder pressure, unburned and burned gas temperatures, rate of heat transfer to the combustion chamber walls, and NO concentration throughout the engine cycle for given engine geometry, speed, intake and exhaust manifold conditions. 10 refs.

DIESEL

REFER ALSO TO CITATION(S) 37500, 37501, 38333, 38334, 38335, 38343, 38344, 38345, 38346, 38349

TURBINE

REFER ALSO TO CITATION(S) 38349

38320 (COO—4867-07) **Gas turbine engines and transmissions for bus demonstration programs. Technical status report, 31 January 1980-30 April 1980.** Nigro, D.N. (Detroit Diesel Allison, Indianapolis, IN (USA)). May 1980. Contract AC02-78CS54867. 7p. NTIS, PC A02/MF A01.

Activities related to the procurement and delivery of 11 gas turbine engines, 11 automatic transmissions, and software items such as cost reports, drawings and parts lists for the bus demonstration program are reported. (LCL)

38321 (DOE/NASA—0017/1) **Ceramic applications in turbine engines. Progress report, 1 July 1979-31 December 1979.** Hudson, S.M.; Janovicz, M.A.; Rockwood, F.A. (General Motors Corp., Indianapolis, IN (USA). Detroit Diesel Allison Div.). May 1980. Contract AI01-77CS51040. 152p. (NASA-CR—159865; DDA-EDR—10156). NTIS, PC A08/MF A01.

Progress made from July 1, 1979 to December 31, 1979 on the application of ceramic materials to an existing industrial gas turbine engine is reported. Excellent progress is noted in building a ceramic materials design data base, establishing design approaches for ceramic components in turbine engines, involving the ceramics industry in fabrication of high technology ceramic components, and defining the true structural, thermal, and chemical environment of ceramic components in turbine engines by rig and engine testing of selected ceramic components. These elements are essential to the highway vehicles. The development of the high-temperature ceramic materials allows increased (relative to metal components) engine-operating temperatures in gas turbine engines. This increased temperature capability yields a more efficient engine that has the potential of reduced fuel usage per mile (by more than 20%). Furthermore, the ceramic components can potentially reduce the cost from that of metal parts and help make feasible a production vehicular (truck, bus, or passenger car) gas turbine. Information is included on engine assembly and testing, materials behavior studies, ceramic turbine components, ceramic regenerator development, and combustor and engine design and development. (LCL)

38322 (DOE/NASA/0027—80/1) **3500-hour durability testing of commercial ceramic materials. Interim report.** Carruthers, W.D.; Richerson, D.W.; Benn, K.W. (AiResearch Mfg. Co., Phoenix, AZ (USA)). Jul 1980. Contract AI01-77CS51040. 229p. (NASA-CR—159785). NTIS, PC A13/MF A01.

A two-year durability testing program was performed by AiResearch Phoenix to evaluate four commercially available ceramic materials under simulated automotive gas turbine combustor discharge conditions. These conditions included extended cyclic thermal exposures up to 2500°F and 3500 h. The four materials selected for evaluation were Norton NCX-34 hot pressed silicon nitride, AiResearch RBN 101 reaction bonded silicon nitride, Carborundum pressureless sintered α-SiC and British Nuclear Fuels, Ltd. Refel reaction sintered silicon carbide marketed by Pure Carbon Co. These materials initially were exposed to 350 h/1750 cycles at 1200 and 1370°C (2200 and 2500°F). Subsequent exposures to 1050, 2100, and 3500 h were performed on the materials maintaining 50% of baseline strength after the initial exposure. Additional evaluations of exposed bars included dimension changes, weight changes, dye penetrant, specific damping capacity changes, Scanning Electron Microscope (SEM) fractography and x-ray diffraction.

38323 **New approach for erosion prediction due to fly ash.** Kotwal, R.; Tabakoff, W. (Univ of Cincinnati, Ohio). *Am. Soc. Mech. Eng., [Pap.]*; No. 80-GT-96, vp(1980).

With increasing interest in the burning of coal in industrial gas turbines, there is also concern for the precise determination of the erosive effects on the turbine components. A series of experiments were conducted to determine the effects of fly ash constituents, particle size, particle velocity, angle of attack and target temperature on the erosion of iron and nickel base alloys. Based on the experimental results, a semi-empirical equation has been obtained for the prediction of the erosion losses. This equation provides a new technique for predicting the metal erosion due to the fly ash produced by the conventional burning of coal. 8 refs.

38324 **Water-cooled gas turbine monometallic nozzle development.** Schilke, P.W.; Blazek, W.S.; Schilling, W.F. (GE, USA). *Am. Soc. Mech. Eng., [Pap.]*; No. 80-GT-97, vp(1980).

This paper describes the materials and processes development required to fabricate the second stage monometallic water-cooled nozzle for the Department of Energy funded High Temperature Turbine Technology (HTTT) program. Materials engineering and development work including alloy selection, hot isostatic pressing (HIP), and heat treat optimization necessary to fabricate this component is described and the results of this work are reported. Specialized processes utilized to achieve tight design tolerances such as TRW's split mold investment casting and shaped tube electrode machining (STEM) are also described. The advantages of these processes are discussed in terms of the overall component design goals. 18 refs.

EXTERNAL COMBUSTION ENGINES

REFER ALSO TO CITATION(S) 38348

ELECTRIC-POWERED SYSTEMS

REFER ALSO TO CITATION(S) 38877

38325 (DOE/ET/26917—T1) **Advanced on-board electric vehicle charger. Final report.** (ESB Technology Co., Yardley, PA (USA)). 31 Dec 1979. Contract AC01-78ET26917. 156p. NTIS, PC A08/MF A01.

The design and development of an on-board charger power module for use in electric vehicles is described. The module operates at 20KHz in a series resonant, half bridge configuration. Circuit design trade-offs, module performance, and solutions to the problems of acoustic noise, maintaining high power factor, circuit protection and operating reliability are discussed. The power module operates from a single phase, 240 V, 50/60 Hz utility line. Average power factor is 0.90; efficiency at maximum power output is 86%. The module is rated to charge a bank consisting of 20 Exide EV-106 batteries (60 cells) to an end voltage of 2.42 V/cell. Physically, the module weighs less than 17 Kg. Projected manufacturing cost at the thousand unit level is $394.00 (1978 dollars).

38326 (SAND—79-1770) **Case against electric vehicles is running out of gas.** Bassett, R.R. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1980. Contract AC04-76DP00789. 17p. (CONF-7909175—1). NTIS, PC A02/MF A01.

From Sandia colloquium on electric vehicles; Albuquerque, NM, USA (19 Sep 1979).

The electric vehicle is no longer just an interesting idea, a specialty item, or a futuristic prototype. People are now beginning to realize that the electric vehicle is part of the solution to a very pressing problem that is affecting everyone. Right now, motorists and transportation executives must come to grips with the sobering fact that internal combustion vehicles are seriously hampered by scarce, expensive fuel supplies and ever more restrictive pollution controls. The alternative exists, and it is the electric vehicle. If oil is used to generate electricity, the system efficiency of the electric vehicle is 20% as compared to 10% for the internal combustion car. The big advantage is that it is a multifueled vehicle because electricity may be generated by using nuclear, coal, solar, wind, hydro, etc. An overview of the status of the electric and hydrid vehicles is presented. Public Law 94-413, The Electric and Hybrid Vehicle Program, sponsored by the Department of Energy, is reviewed. The state-of-progress of electric vehicle technology (controls, drive systems, energy storage) is discussed. Available electric vehicles are noted with their specifications. The electric vehicle is not the option for tomorrow; it is, in fact, the answer for today.

38327 (UCRL—15290(Vol.1)) **Regenerative flywheel energy storage system. Volume I. Executive summary.** (General Electric Co., Schenectady, NY (USA). Corporate Research and Development Dept.). 27 Jun 1980. Contract W-7405-ENG-48. 37p. (SRD—79-148-1). NTIS, PC A03/MF A01.

This report describes the development, fabrication, and test of a regenerative flywheel energy storage and recovery system for a battery/flywheel electric vehicle of the 3000-pound class. The vehicle propulsion system was simulated on a digital computer in order to determine the optimum system operating strategies and to establish a calculated range improvement over a nonregenerative, all-electric vehicle. Fabrication of the inductor motor, the flywheel, the power conditioner, and the system control are described. Test results of the system operating over the SAE J227a Schedule D driving cycle are given and are compared to the calculated value. The flywheel energy storage system consists of a solid rotor, synchronous, inductor-type, flywheel drive machine electrically coupled to a d-c battery electric propulsion system through a load-commutated inverter. The motor/alternator unit is coupled mechanically to a small steel flywheel which provides a portion of the vehicle's accelerating energy and regenerates the vehicle's braking energy. Laboratory simulation of the electric vehicle propulsion system includes a 108-volt, lead-acid battery bank and a separately excited d-c propulsion motor coupled to a flywheel and generator which simulate the vehicle's inertia and losses. This volume summarizes information on the scope of the program, vehicle system studies, the flywheel system design, vehicle power conditioner and control, and test results. (LCL)

38328 (UCRL—15290(Vol.2)) **Regenerative flywheel storage system. Volume II. Final report.** (General Electric Co., Schenectady, NY (USA). Corporate Research and Development Dept.). 27 Jun 1980. Contract W-7405-ENG-48. 226p. (SRD—79-148-2). NTIS, PC A11/MF A01.

This report describes the development, fabrication, and test of a regenerative flywheel energy storage and recovery system for a battery/flywheel electric vehicle of the 3000-lb class. The vehicle

propulsion system was simulated on a digital computer in order to determine the optimum system operating strategies and to establish a calculated range improvement over a nonregenerative, all-electric vehicle. Fabrication of the inductor motor, the flywheel, the power conditioner, and the system control are described. Test results of the system operating over the SAE J227a Schedule D driving cycle are given and are compared to the calculated value. The flywheel energy storage system consists of a solid rotor, synchronous, inductor-type, flywheel drive machine electrically coupled to a d-c battery electric propulsion system through a load-commutated inverter. The motor/alternator unit is coupled mechanically to a small steel flywheel which provides a portion of the vehicle's accelerating energy and regenerates the vehicle's braking energy. Laboratory simulation of the electric vehicle propulsion system includes a 108-volt, lead-acid battery bank and a separately excited d-c propulsion motor coupled to a flywheel and generator which simulate the vehicle's inertia and losses. This volume reports the theoretical and experimental studies which were performed and the results of these studies.

38329 (UCRL—15290(Vol.3)) **Regenerative flywheel energy storage system. Volume III. Life-cycle and cost-benefit analysis of a battery-flywheel electric car.** (General Electric Co., Schenectady, NY (USA). Corporate Research and Development Dept.). 27 Jun 1980. Contract W-7405-ENG-48. 194p. (SRD—79-148-3). NTIS, PC A09/MF A01.

This report describes the development, fabrication, and test of a regenerative flywheel energy storage and recovery system for a battery/flywheel electric vehicle of the 3000-lb class. The vehicle propulsion system was simulated on a digital computer in order to determine the optimum system operating strategies and to establish a calculated range improvement over a nonregenerative, all-electric vehicle. Fabrication of the inductor motor, the flywheel, the power conditioner, and the system control is described. Test results of the system operating over the SAE J227a Schedule D driving cycle are given and are compared to the calculated value. The flywheel energy storage system consists of a solid rotor, synchronous, inductor-type, flywheel drive machine electrically coupled to a d-c battery electric propulsion system through a load-commutated inverter. The motor/alernator unit is coupled mechanically to a small steel flywheel which provides a portion of the vehicle's accelerating energy and regenerates the vehicle's braking energy. Laboratory simulation of the electric vehicle propulsion system includes a 108-volt, lead-acid battery bank and a separately excited d-c propulsion motor coupled to a flywheel and generator which simulate the vehicle's inertia and losses. This volume presents the life-cycle and cost-benefit analyses of the proposed battery/flywheel electric vehicle.

HYBRID SYSTEMS

REFER ALSO TO CITATION(S) 38327, 38328, 38329

38330 (DOE/JPL/955188—01) **Phase I of the Near-Term Hybrid Passenger-Vehicle Development Program. Final report.** (Minicars, Inc., Goleta, CA (USA)). Oct 1980. Contract NAS-7-100-955188. 146p. NTIS, PC A07/MF A01.

Under contract to the Jet Propulsion Laboratory of the California Institute of Technology, Minicars conducted Phase I of the Near-Term Hybrid Passenger Vehicle (NTHV) Development Program. This program led to the preliminary design of a hybrid (electric and internal combustion engine powered) vehicle and fulfilled the objectives set by JPL. JPL requested that the report address certain specific topics. A brief summary of all Phase I activities is given initially; the hybrid vehicle preliminary design is described in Sections 4, 5, and 6. Table 2 of the Summary lists performance projections for the overall vehicle and some of its subsystems. Section 4.5 gives references to the more-detailed design information found in the Preliminary Design Data Package (Appendix C). Alternative hybrid-vehicle design options are discussed in Sections 3 through 6. A listing of the tradeoff study alternatives is included in Section 3. Computer simulations are discussed in Section 9. Section 8 describes the supporting economic analyses. Reliability and safety considerations are discussed specifically in Section 7 and are mentioned in Sections 4, 5, and 6. Section 10 lists conclusions and recommendations arrived at during the performance of Phase I. A complete bibliography follows the list of references.

38331 (DOE/JPL/955189—01) **Phase I of the Near-Term Hybrid Passenger-Vehicle Development Program. Final report.** (South Coast Technology, Inc., Santa Barbara, CA (USA)). Oct 1980. Contract NAS-7-100-955189. 154p. NTIS, PC A08/MF A01.

Heat engine/electric hybrid vehicles offer the potential of greatly reduced petroleum consumption, compared to conventional vehicles, without the disadvantages of limited performance and operating range associated with purely electric vehicles. This report documents a hybrid-vehicle design approach which is aimed at the development of the technology required to achieve this potential - in such a way that it is transferable to the auto industry in the near term. The development of this design approach constituted Phase I of the Near-Term Hybrid-Vehicle Program. The major tasks in this program were: (1) Mission Analysis and Performance Specification Studies; (2) Design Tradeoff Studies; and (3) Preliminary Design. Detailed reports covering each of these tasks are included as appendices to this report and issued under separate cover; a fourth task, Sensitivity Studies, is also included in the report on the Design Tradeoff Studies. Because of the detail with which these appendices cover methodology and both interim and final results, the body of this report was prepared as a brief executive summary of the program activities and results, with appropriate references to the detailed material in the appendices.

38332 (DOE/JPL/955190—01) **Phase I of the Near Term Hybrid Passenger Vehicle Development Program. Final report.** (General Electric Co., Schenectady, NY (USA)). Oct 1980. Contract NAS-7-100-955190. 132p. NTIS, PC A07/MF A01.

The results of Phase I of the Near-Term Hybrid Vehicle Program are summarized. This phase of the program ws a study leading to the preliminary design of a 5-passenger hybrid vehicle utilizing two energy sources (electricity and gasoline/diesel fuel) to minimize petroleum usage on a fleet basis. This report presents the following: overall summary of the Phase I activity; summary of the individual tasks; summary of the hybrid vehicle design; summary of the alternative design options; summary of the computer simulations; summary of the economic analysis; summary of the maintenance and reliability considerations; summary of the design for crash safety; and bibliography.

FLYWHEEL PROPULSION

REFER ALSO TO CITATION(S) 38327, 38328, 38329

ENGINE-TRANSMISSION MATCHING

REFER ALSO TO CITATION(S) 38320

EMISSION CONTROL

REFER ALSO TO CITATION(S) 38348, 38562

38333 (PB—80-100795) **Application for certification 1979 model year heavy-duty diesel engines - Caterpillar Tractor Co.** (Caterpillar Tractor Co., Peoria, IL (USA)). Oct 1979. 8 sheetsp. Also available in set of 3 reports MF$8.00, PB80-100787.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles or heavy-duty engines submits to EPA an application for certification. The application consists of two parts. In Part I, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. Part I also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. The Part II application submitted after emission testing is completed, contains the results of emission testing, a statement of compliance to the regulations, and maintenance instructions to be followed by the ultimate owners of the vehicles.

38334 (PB—80-100803) **Application for certification 1979 model year heavy-duty diesel engines - Isuzu Motors Ltd.** (Isuzu Motors Ltd., Southfield, MI (USA)). Oct 1979. 3 sheetsp. Also available in set of 3 reports MF$8.00, PB80-100787.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles or heavy-duty engines submits to EPA an application for certification. The application consists of two parts. In Part I, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. Part I also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. The Part II application submitted after emission testing is completed, contains the results of emission testing, a statement of compliance to the regulations, and maintenance instructions to be followed by the ultimate owners of the vehicles.

38335 (PB—80-100811) **Application for certification 1979 model year heavy-duty diesel engines - Mack Trucks, Inc.** (Mack Trucks, Inc., Hagerstown, MD (USA)). Oct 1979. 2 sheetsp. Also available in set of 3 reports MF$8.00, PB80-100787.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles or heavy-duty engines submits to EPA an application for certification. The application consists of two parts. In Part I, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. Part I also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. The Part II application submitted after emission testing is completed, contains the results of emission testing, a statement of compliance to the regulations, and maintenance instructions to be followed by the ultimate owners of the vehicles.

38336 (PB—80-100829) **Application for certification 1979 model year light-duty vehicles and trucks - Isuzu Motors Ltd.** (Isuzu Motors Ltd., Southfield, MI (USA)). Oct 1979. 8p. NTIS, PC A02/MF A01.

Every year, each manufacturer of passenger cars, light-duty trucks, motorcycles or heavy-duty engines submits to EPA an application for certification. The application consists of two parts. In Part I, the manufacturer gives a detailed technical description of the vehicles or engines he intends to market during the upcoming model year. These engineering data include explanations and/or drawings which describe engine/vehicle parameters such as basic engine design, fuel systems, ignition systems and exhaust and evaporative emission control systems. Part I also provides information on emission test procedures, service accumulation procedures, fuels to be used, and proposed maintenance requirements to be followed during testing. The Part II application submitted after emission testing is completed, contains the results of emission testing, a statement of compliance to the regulations, and maintenance instructions to be followed by the ultimate owners of the vehicles.

38337 (PB—80-128309) **A study of exhaust emissions from 1977-1978 model year motorcycles. Technical report.** Moore, L.; Burke, J. (Automotive Environmental Systems, Inc., Westminster, CA (USA)). May 1979. Contract EPA-68-03-2374. 168p. NTIS, PC A08/MF A01.

This report presents data obtained as a result of testing and inspection of 150 1977 and 1978 model year motorcycles in the Los Angeles, California area. All vehicles were consumer-owned, street-legal motorcycles. Each vehicle was initially tested in as-received condition by the 1978 Federal Test Procedure. This includes evaporative emissions measurements as well as the exhaust emissions tests. A number of additional tests were performed on some or all vehicles. These included a Two-Speed Idle test, the Highway Fuel Economy test, a model emissions test, the Federal Short Cycle test, the New York/New Jersey test and the Federal Three Mode test.

38338 (PB—80-128473) **A study of exhaust emissions from 1975-1979 model year passenger cars in Los Angeles. Final report.** Moore, L.; Unger, D.C. Jr. (Automotive Environmental Systems, Inc., Westminster, CA (USA)). Jul 1979. Contract EPA-68-03-2590. 240p. NTIS, PC A11/MF A01.

This report presents data obtained as a result of testing and inspection of 125 1975 thru 1977 vehicles with greater than 50,000 miles, 72 1978 3-way catalyst vehicles and a group of 53 1979 vehicles, mostly with 3-way catalysts. The test fleet was obtained randomly from private owners in the Los Angeles and Orange County areas. Testing was performed from January 1979 through June 1979.

38339 (PB—80-804479) **Automobile air pollution: exhaust analysis (citations from the NTIS data base). Report for 1970-Jan 80.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Feb 1980. 214p. NTIS PC N01/MF N01.

Methods of analyzing the exhaust from automobiles are covered in these citations. The techniques include gas chromatography, mass spectroscopy, and infrared spectroscopy. Reports are presented on monitors, types of emissions, smoke measurement, and exhaust composition. The studies cover direct and remote sampling and analytical techniques. (This updated bibliography contains 207 abstracts, 9 of which are new entries to the previous edition.)

38340 (PB—80-804685) **Automobile air pollution: control equipment. Volume 1. 1964-1978 (citations from the NTIS data base). Report for 1964-78.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Feb 1980. 266p. NTIS PC N01/MF N01.

Research reports on air pollution control equipment used in automobiles are cited. Topics include the design and performance of catalytic and thermal reactors, retrofit devices, carburetors, and ignition timing systems. Also covered are studies of the catalysts as well as the equipment regulations that the industry must follow. (This updated bibliography contains 259 abstracts, none of which are new entries to the previous edition.)

38341 (PB—80-804693) **Automobile air pollution: control equipment. Volume 2. 1979-January, 1980 (citations from the NTIS data base). Report for 1979-jan 80.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Feb 1980. 66p. NTIS PC N01/MF N01.

This bibliography of Federally-sponsored research cites control equipment and retrofit techniques to control automobile exhaust emissions. The topics include the design and performance of catalytic and thermal reactors, retrofit devices, carburetors, and ignition timing systems. Also covered are studies of the catalysts as well as the equipment regulations that the industry must follow. (This updated bibliography contains 59 abstracts, all of which are new entries to the previous edition.)

38342 (PB—80-804701) **Automobile air pollution: control equipment--catalytic converters. Volume 2. 1977-January, 1980 (citations from the Engineering Index Data Base). Report for 1977-Jan 80.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Feb 1980. 149p. NTIS PC N01/MF N01.

The citations of worldwide engineering literature cover automotive catalytic converters. Included are such topics as converter design and materials, performance tests, effectiveness in pollutant reduction, catalyst poisoning, catalyst selection, chemistry involved in the emission control, and the overall feasibility of using these converters under normal driving conditions. Control of sulfuric acid and sulfate emissions is also discussed. (This updated bibliography contains 142 abstracts, 37 of which are new entries to the previous edition.)

38343 (PB—80-805385) **Diesel exhaust emissions. Volume 2. 1977-January 1980 (citations from the NTIS data base). Report for 1977-Jan 1980.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Feb 1980. 159p. NTIS PC N01/MF N01.

Aspects of exhaust gases from stationary and vehicular diesel engines are presented in these citations of Federally-funded research. This includes pollution potential, composition, control, and formation processes in combustion reactions. The effects of achieving better fuel consumption on the types of exhaust gases formed is covered. Also cited is research concerned with the health effects of these exhaust gases. (This updated bibliography contains 152 abstracts, 45 of which are new entries to the previous edition.)

38344 (PB—80-805393) **Diesel exhaust emission control for motor vehicles. Volume 1. 1970-1977 (citations from the Engineering Index data base). Report for 1970-1977.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Feb 1980. 213p. NTIS PC N01/MF N01.

Research from worldwide journal literature on the control of exhaust gases from diesel motor vehicle engines is cited. Most studies are concerned with emission control through engine design; however, some studies cover the use of fuel additives for pollution control. (This updated bibliography contains 206 abstracts, none of which are new entries to the previous edition.)

38345 (PB—80-805401) **Diesel exhaust emission control for motor vehicles. Volume 2. 1978-January 1980 (citations from the Engineering Index data base). Report for 1978-Jan 1980.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Feb 1980. 110p. NTIS PC N01/MF N01.

Citations to worldwide research were selected that discuss the control of exhaust gases from diesel motor vehicle engines. Most of the studies are concerned with emission control through engine design; however, some studies also cover the use of fuel additives for pollution control. (This updated bibliography contains 103 abstracts, 48 of which are new entries to the previous edition.)

38346 (PB—80-805419) **Diesel exhaust emissions (citations from the American Petroleum Institute Data Base). Report for 1974-Dec 1980.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Feb 1980. 204p. NTIS PC N01/MF N01.

This bibliography cites research reports concerning exhaust emissions from diesel motor vehicles. Topics include engine design, techniques of measuring gases, pollution control, and fuel additives. (This updated bibliography contains 197 abstracts, 42 of which are new entries to the previous edition.)

NITROGEN OXIDES

REFER ALSO TO CITATION(S) 38319

HYDROCARBONS

38347 (DOE/ET/13329—T1) **Wall quench and flammability limit effects on exhaust hydrocarbon emissions. Final technical report,**

Phase 5: 1 August 1980-30 September 1980. Fendell, F. (TRW Defense and Space Systems Group, Redondo Beach, CA (USA). Engineering Sciences Lab.). Oct 1980. Contract AC04-78ET13329. 16p. NTIS, PC A02/MF A01.

Progress is reported in a project concerned with simple modeling and laboratory experiments to elucidate the mechanisms whereby trace amounts of unburned hydrocarbons may persist after the combustion event in Otto-cycle-type internal-combustion-engine cylinders, and the fate of these residual hydrocarbons during the power-stroke and exhaust-event portions of the cycle. The motivation for the research is that a highly fuel-lean fast-burn design for the spark-ignition homogeneous-charge, four-stroke engine may permit exceptionally fuel-efficient operation of this highly driveable, relatively well-understood automotive engine. Work during this period concentrated on the mathematical modelling of wall quenching and turbulent flame propagation. (LCL)

ALTERNATIVE FUELS

REFER ALSO TO CITATION(S) 37500, 37501

38348 (DOE/ERD—0027) **Environmental readiness document. Transportation programs, FY 1980: alcohol fuels; organic Rankine cycle system working fluids.** (Department of Energy, Washington, DC (USA). Office of Environmental Assessments). Sep 1980. 113p. NTIS, PC A06/MF A01.

This Environmental Readiness Document was prepared to assist DOE in evaluating the commercial readiness of two transportation programs technologies: alcohol fuels utilization and organic Rankine cycle system working fluids, with respect to environmental issues. An effort has been made to identify potential environmental problems that may be encountered based on current knowledge, proposed and possible new environmental regulations, and the uncertainties inherent in planned environmental research. It is concluded that alcohol fuels, neat or mixed, appear to have a high probability of achieving environmental acceptability, and that the organic working fluids proposed for Rankine cycle systems for recovering heat from engines must be evaluated carefully for potential public health risks related to flammability, toxicity, mutagenicity/carcinogencity, and ecological effects. (LCL)

38349 (FE—2468-77) **Alternate fuels for industrial combustion engines. Final report on Task 018.** Thomas, R.L. (Engineering Societies Commission on Energy, Inc., Washington, DC (USA)). Jun 1980. Contract AC01-77ET10679. 96p. NTIS, PC A09/MF A01.

In this study, the various options for producing alternate fuels (synfuels) for large industrial combustion engine use are examined from the standpoint of current fuel usage and future engine development trends. This general class of engine in sizes above 1500 horsepower is widely utilized in the utility, transportation and industrial sectors to meet a variety of mechanical power needs. Consequently, industrial engine fuel demands are expected to be an important consideration as to which alternate fuels are developed as well as their commercial properties. The broad conclusions of this study are: (1) The current emphasis on the development of various concepts for the processng of gaseous and distillate fuels from coal and shale will provide a reliable fossil fuel source for industrial engine utilization well beyond the year 2000. (2) Engine emission requirements will largely dictate the degree of upgrading (cost) of alternate engine fuels and their commercial specifications as well as the overall efficiency of the entire energy system from resource to engine output. (3) The present lack of sufficient quantities of alternate fuels for engine development implies a need for fundamental research leading to an improved understanding of fuel properties and their relationship in predicting emission performance and fuel flexibility of engine designs.

MATERIALS

METALS AND ALLOYS

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 37717, 37899, 38353, 38523

38350 (BDX—613-2485) **Ultrasonic aluminum wire bonding. Final report.** Sim, J.R. (Bendix Corp., Kansas City, MO (USA)). Sep 1980. Contract AC04-76DP00613. 29p. NTIS, PC A03/MF A01.

An aluminum wire bonding process was developed. Techniques were developed for bonding large diameter wire to a power transistor and evaporated gold. Bond schedules were made to be used in producing hybrid microcircuits. Calibration techniques utilizing an elctromagnetic transducer to measure tool movement proved successful. The magnetic transducer is best suited as a trouble-shooting tool.

38351 (DOE/ET/12313—T1) **Characterizing and improving the toughness of thick-sectioned 2 1/4 Cr-1 Mo electroslag weldments.** Edwards, G.R.; Frost, R.H. (Colorado School of Mines, Golden (USA). Dept. of Metallurgial Engineering). 1 Sep 1980. Contract AS01-78ET12313. 138p. NTIS, PC A07/MF A01.

Efforts to improve the toughness of electroslag weldments consisted of four endeavors: process control, changes caused in 2 1/4 Cr-1 Mo steel by electroslag welding and post-weld heat treatment, electrochemical reactions during the electroslag welding, and toughness testing.

38352 (DOE/OR/10244—9) **Handbook for electron beam welding of 8-inch thick 2-1/4 Cr-1 Mo.** Weber, C.M. (Babcock and Wilcox Co., Alliance, OH (USA). Research and Development Div.). Aug 1980. Contract AC05-77OR10244. 11p. NTIS, PC A02/MF A01.

Purpose of this handbook is to provide a detailed procedure for electron beam welding 8 in. thick SA387 Grade 22 Class 2. Adherence to the procedure will allow others to produce electron beam welds in 8 in. thick 2-1/4 Cr-1 Mo. A justification or description of the effects of alterations of the welding procedure is not included in this report. These effects, along with a metallographic characterization and the mechanical properties produced by the welding procedure, etc., are described in report DOE/10244-10, Electron Beam Welding of 8-in. thick 2-1/4 Cr-1 Mo, Final Report under Contract DE-AC05-77OR10244.

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 37717

38353 (CONF-800928—4) **Epitaxial (111) Pd films formed on (111) Cu.** Chao, S.S.; Vook, R.W.; Knabbe, E.A. (Syracuse Univ., NY (USA). Dept. of Chemical Engineering and Materials Science). 1980. Contract AS02-77ER04496. 5p. NTIS, PC A02/MF A01.

From 8. international vacuum congress/ 4. international conference on surface science and 3. European conference on solid surface; Cannes, France (22 Sep 1980).

Epitaxial Pd films ranging in thickness from 1 A up to 45 A were formed by thermal evaporation on (111) Cu substrate films at 25°C under UHV conditions. The growth of these Pd films was investigated by in situ RHEED techniques. Subsequent examinations of the Pd/Cu bilayers by TEM, TED, and RHEED were used to characterize the microstructures and strain associated with growth. TEM shows misfit dislocations everywhere across the interface at a Pd overlayer thickness of 5 A or more, indicating complete surface coverage after about two average monolayers have been deposited. Strain and dislocation spacing measurements suggest the presence of two separate misfit dislocation networks at the interface. RHEED and TED measurements show a reduction in strain in the Pd overgrowth with increasing thickness at a rate somewhat less than predicted by van der Merwe.

38354 **Desorption isotherms of $DyFe_3$ hydrides.** Kierstead, H.A. (Argonne National Lab., IL). *J. Less-Common Met.;* **71**: 311-315(1980).

Desorption isotherms for the $DyFe_3$-H system were obtained at 0°C and 20°C. The isotherms are analyzed in terms of a theory of multiplateau hydrogen absorption recently published by the author. Changes observed in the isotherms in successive absorption-desorption cycles are described.

38355 (ORNL—5665, pp 61-67) **High-temperature chemistry and thermodynamics of structural materials.** Jul 1980.

In Chemistry Division annual progress report, February 29, 1980.

Tritium permeabilities were measured in nonoxidized alloys (steels, Ni alloys, W alloys) and in alloys oxidized by subatmospheric steam. Carbide precipitates in low-alloy Cr-Mo-C ferritic steels were analyzed. The Fe-Cr-C tau carbide phase in Fe-Cr-Mo steels was found to have a Fe/Cr ratio of 0.32 +- 0.02 and a M/C ratio of 3.35 +- 0.05, indicating that the $M_{23}C_6$ composition is either erroneous or variable. The eta carbides and the Fe-Cr sigma phase in steels were also studied. (DLC)

38356 **Thermocouple temperature measurements in shock-compressed solids.** Bloomquist, D.D.; Sheffield, S.A. (Sandia National Laboratories, Albuquerque, New Mexico 87185). DE-AC04-76-DP00789. *J. Appl. Phys.;* **51**: No. 10, 5260-5266(Oct 1980).

The emf produced by 5-μm-thick foil thermocouples when subjected to shock loading was studied over a stress range from 0.5 to 10 GPa. Thermocouples of either copper and constantan or chromel and alumel were embedded in the host materials, polymethyl methacrylate (PMMA), Epon 828 epoxy, single-crystal Al_2O_3, or vitreous SiO_2. The observed emf history rises to a plateau

in a period that varied from less than 100 ns for Al_2O_3 to about 500 ns for PMMA. Temperatures inferred from the constant-voltage portion of the records using standard thermocouple tables (corrected for pressure) compare favorably with calculated temperatures for PMMA and epoxy below 2.0 and 4.5 GPa, respectively. Above these threshold stresses, the observed temperatures increase rapidly with compression, which may indicate an exothermic reaction. Inferred temperatures for the two types of thermocouples are in good agreement. The shape of the response history, and agreement with predicted temperatures for PMMA and epoxy, indicate that the thermocouple and host material come to thermal equilibrium during the transient portion of the response. In the elastic materials Al_2O_3 and SiO_2, the observed temperatures are better correlated with temperatures predicted for shock compression of the thermocouple materials than those predicted for the host materials, indicating that thermal equilibration is not achieved in the available test time.

38357 Matrix formulation for choosing starting sets in direct methods. Andrews, L.C. (Brookhaven National Lab., Upton, NY). *Acta Crystallogr., Sect. A;* **35**: 695-696(1979).

A method for finding the strongest starting set of reflections for multisolution direct methods is proposed and compared with the Convergence Method of Germain, Main & Woolfson.

38358 X-ray linear absorption coefficients for silicon and germanium in the energy range 5 to 50 keV. Hildebrandt, G. (Fritz-Haber-Institut der Max-Planck-Gesellschaft, Faradayweg, Berlin). *Acta Crystallogr., Sect. A;* **35**: 696-697(1979).

Experimental absorption data from different authors are commented on, critically evaluated, and presented in a table.

38359 Misfit dislocations in (001) Cu/(111) Ag epitaxial bilayers. Vook, R.W.; Chao, S.S. (Syracuse Univ., New York). *Thin Solid Films;* **58**: 203-207(1979).

Two sets of elongated epitaxial (111) Ag islands rotated by 90° with respect to each other were observed to grow on (001) Cu substrates. In addition, two sets of edge misfit dislocations lay parallel to [110] Cu and [110] Cu or equivalently along [110] Ag and [112] Ag. Their Burgers vectors were determined, together with the elastic strains in these two directions. The island elongation was interpreted as arising from a lower strain energy in the preferred direction of growth.

38360 Thermomodulation of the aluminum L/sub 2 3/ absorption edge. Olson, C.G.; Lynch, D.W. (Ames Lab., IA). Contract W-7405-ENG-82. *Solid State Commun.;* **31**: No. 9, 601-605(1979).

Thermotransmission spectra were obtained near the Al L/sub 2 3/ edge in Al films, using synchrotron radiation. These spectra, temperature derivatives of the absorption coefficient, completely resolve the two spin-orbit components. A fit to the shape of one component shows that broadening of the Fermi function is the dominant mechanism for the temperature dependence of the edge. An additional mechanism, a temperature-dependent one-electron or many-body absorption process, is needed near the region of the spike.

38361 High-temperature solid-solution strengthening studied through internal friction. Schwarz, R.B. (Argonne National Lab., IL). pp 953-958 of Strength of metals and alloys. Haasen, P. (ed.). New York, NY; Pergamon Press (1979).

A new model has been developed for amplitude-dependent internal friction due to dislocation motion through a random distribution of weak obstacles of finite interaction range and in the presence of viscous forces. The logarithmic decrement, δ, has been expressed as a function of normalized values of the stress amplitude, interaction range, viscous damping and frequency. Numerical calculations have been performed for selected values of these parameters using a previously developed computer code. A simple expression for δ has been found for overdamped dislocations which also provides a direct correspondence between amplitude-dependent internal friction and flow-stress measurements. The calculations have been used to interpret internal friction measurements in Al-Mg alloys for $80 < T < 600$ K; this yields information about the alloy properties that cannot be deduced from macroscopic flow-stress measurements alone.

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 38125, 38351, 38361, 39184

38362 (DOE/ET/10698—T2) **Wear resistant alloys for coal handling equipment. Progress report, October 1, 1977-September 30, 1979.** Bhat, M.S.; Zackay, V.F.; Parker, E.R.; Finnie, I. (California Univ., Berkeley (USA). Dept. of Mechanical Engineering). 1979. Contract AT03-76ET10698. 319p. NTIS, PC A14/MF A01.

The objective is to utilize advances in low alloy steels with high strength, hardness, and toughness to develop wrought and cast steels for improved coal transportation and fragmentation equipment. The program consists of three tasks: alloy performance criteria, alloy design, and component evaluation. Good progress was made in the first two tasks. (DLC)

38363 Method of finite elements: Scope of application in fracture mechanics. Dahl, W.; Redmer, J. (Technische Hochschule Aachen (Germany, F.R.). Inst. fuer Eisenhuettenkunde). *Maschinenmarkt;* **86**: No. 9, 151-153(Jan 1980). (In German).

FEM (finite element method) today is used in linear-elastic as well as elastoplastic fracture mechanics. The important parameter is the factor of critical stress intensity. Elastoplastic stress and dislocation fields may be calculated in two and three dimensions. It is also possible to look for criteria to be transferred. The local conditions directly in front of the tip of the crack are of importance. The problem of the long computing times that sometimes is still existing today will become less important if new computer generations are introduced.

38364 Two new expressions for J. Burns, S.J. (Univ. of Rochester, NY). *Int. J. Fract.;* **15**: R115-R116(1979).

In nonlinear fracture mechanics the importance of the generalized force J, on a crack-like feature in an elastic solid, has been well established. The value of J in turn has been related to the load-displacement curve of any nonlinear elastic solid that contains a crack.

38365 Sulfur and phosphorus segregation in duplex stainless steel weld metal. Lyman, C.E. (Rensselaer Polytechnic Inst., Troy, NY). pp 135-138 of Microbeam analysis - 1979. Newbury, D.E. (ed.). San Francisco, CA; San Francisco Press, Inc. (1979).

Phosphorus, and possibly sulfur, partitions to the delta ferrite phase in duplex stainless steel welds are shown. This partitioning probably contributes to the elimination of hot cracking in welded austenitic stainless steels containing retained delta ferrite.

38366 Chemistry of fracture. Burns, S.J.; Pollet, J.C. (Univ. of Rochester, NY). pp 70-90 of Materials and national policy. Washington, DC; American Chemical Society (1978).

A kinetic description of a single, unspecified, rate controlling mechanism at the crack tip is described. The kinetics of this unspecified process defines the relationships between the crack velocity, temperature and applied mechanical force. Observation of a crack velocity as a function of temperature and the force applied to the crack can thus provide a description of the rate controlling process of crack propagation. This paper is divided into two parts: the first part uses reversible fracture mechanics to deduce the generalized mechanical force at the crack tip assuming the load, the displacement of the load and the crack area are measurable; the second part assumes a single unspecified thermally activated mechanism as the rate controlling process in the fracture modified material at the crack tip. The relationships between crack velocity, temperature and applied force are obtained from the Arrhenius equation of chemical kinetics.

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 38354, 38359, 38925, 39164

38367 Magnetization density in ferromagnetic TiBe/sub 1.8/Cu/sub 0.2/. Felcher, G.P.; Cable, J.W.; Smith, J.L. (Argonne National Laboratory, Argonne, Illinois 60439). W-7405-ENG-26. *Phys. Rev. Lett.;* **45**: No. 9, 751-753(1 Sep 1980).

The distribution of magnetization in the weak itinerant ferromagnetic TiBe/sub 1.8/Cu/sub 0.2/ has been determined by polarized-neutron diffraction. The magnetization resides on the titanium sites forming an interlocked tetrahedral network. No magnetization is present at the beryllium sites, into which copper goes substitutionally.

38368 Proximity electron tunneling spectroscopy I. Experiments in Nb. Wolf, E.L.; Zasadzinski, J.; Osmun, J.W.; Arnold, G.B. (Ames Laboratory: USDOE and Department of Physics, Iowa State University, Ames, Iowa). *J. Low Temp. Phys.;* **40**: No. 1, 19-50(1 Jul 1980).

A quantitative proximity electron tunneling spectroscopy (PETS) id demonstrated for the study of strong coupling superconductors which do not form suitable insulating oxides for conventional McMillan—Rowell tunneling spectroscopy. Proximity junctions of the form C-Al_2O_3-Al/S are employed, with Al thickness d/sub N/ < or = 100 A. Here S is the superconductor of interest and C is any convenient counterelectrode. The physical basis for the method, experimental techniques, and data obtained from foils of Nb are presented. The results for Nb include the energy-dependent pair potential Δ/sub s/(E), the renormalization function Z(E), effective phonon spectrum $\alpha^2F(\omega)$, electron-phonon coupling constant λ, and Coulomb pseudopotential μ^*. A full discussion of the underlying theory and details of the methods of analysis employed to obtain, in addition, the pair potential of the Al proximity layer are contained in a following paper.

38369 Normal spectral emissivity of liquid cerium-copper alloys. Dokko, W. (Jet Propulson Lab., Pasadena, CA); Bautista, R.G. *Metall. Trans., B;* **11B**: No. 2, 309-312(Jun 1980).

The normal spectral emissivities ($\lambda = 0.645$ nm) of liquid Ce-Cu alloys were measured over the complete range of composition by the integral blackbody comparison method. Composition analyses of the solidified and segmented samples confirmed their homogeneity. It was found that the observed values of the normal spectral emissivity for every composition was constant over the experimental temperature range studied. The composition dependence of the emissivity can be expressed by the equation $\epsilon/\text{sub n}\ \lambda/ = 0.2920 - 0.0650\ X + 0.2242\ X^2 + 1.1381\ X^3 - 1.4773\ X^4$ where $\epsilon/\text{sub n}\ \lambda/$ is the normal spectral emissivity at n $\lambda = 0.645\ \mu$ and X is the mole fraction of copper.

38370 Theory of multiplateau hydrogen absorption isotherms. Kierstead, H.A. (Argonne National Lab., IL). *J. Less-Common Met.;* **71**: 303-309(1980).

An extension of Lacher's theory of hydrogen absorption isotherms is presented which is applicable to isotherms with more than one plateau. The theroy is illustrated by fitting the isotherms of $ErFe_2H/\text{sub x}/$.

38371 Determination of core and valence electron enhancement factors in positron annihilation studies. Gupta, R.P.; Siegel, R.W. (Argonne National Lab., IL (USA)). *J. Phys., F (London);* **9**: No. 12, 2353-2358(Dec 1979).

A new method is proposed by means of which the core and valence electron enhancement factors can be extracted from experimentally measured positron annihilation angular-correlation curves in conjunction with theoretical calculations. As an example, the method is applied to obtain the average enhancement factors for aluminium. However, the method is generally applicable to all classes of materials.

CORROSION AND EROSION

REFER ALSO TO CITATION(S) 37479, 37528, 37538, 38125, 38473, 38474, 38564, 38565

38372 (DOE/NASA/2593—18) **Improved bond coatings for use with thermal barrier coatings.** Gedwill, M.A. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Sep 1980. Contract AI01-77ET10350. 46p. (NASA-TM—81567). NTIS, PC A03/MF A01.

The potential for improving the durability of thermal barrier coatings (TBC's) ZrO_2-Y_2O_3 being developed for coal-derived-fuel-fired gas turbines was studied. Furnace oxidation behavior of plasma-deposited bond coatings was improved by increasing the thickness from 0.010 to 0.015 cm and by depositing the coatings at 20 kW with argon- 3.5-vol% hydrogen arc gas rather than at 11 kW with argon. The most oxidation resistant plasma-deposited bond coatings were Ni-14.1Cr-13.4Al-0.10Zr, Ni-14.3Cr-14.4Al-0.16Y, and Ni-15.8Cr-12.8Al-0.36Y on B-1900 + Hf and Ni-30.9Cr-11.1Al-0.48Y on MAR-M-509. The oxidation resistant bond coatings improved TBC life when the coatings were deposited on the specimens supported on a nail bed fixture during coatings.

38373 (EPRI-CS—1454) **High-temperature erosion-corrosion of alloys. Final report.** Wright, I.G.; Herchenroeder, R.B. (Battelle Columbus Labs., OH (USA); Cabot Corp., Kokomo, IN (USA)). Jul 1980. 230p. NTIS, PC A11/MF A01.

In a fluidized-bed combustion system, the combustion gases will normally pass over various heat exchange surfaces and other components before being exhausted. In conventional pulverized coal-fired boilers, erosion of the gas-pass heat exchangers may occur, and such boilers are designed to maximum nominal gas velocities which depend, to some extent, on the ash content and type. There is little understanding of the mechanism of the erosion processes or the basis for the empirically derived maximum velocity. This study has developed an apparatus for the study of erosion processes at elevated temperatures and has examined the erosion of a wide range of alloys by 15 μm alumina particles at 63 and 170 fps (19 and 53 m/s) at temperatures up to 1600°F (871°C) in argon a simulated combustion gas, and a simulated gasifier atmosphere.

38374 (FE—2299-29) **Sulfidation-resistant alloy/cladding for internal components of coal conversion equipment. Quarterly report, October 1-December 31, 1978.** Vonk, S.J.; Perkins, R.A. (Lockheed Palo Alto Research Labs., CA (USA)). 1978. Contract EX-76-C-01-2299. 19p. NTIS, PC A02/MF A01.

Evaluation of a number of Fe-Cr-Al-Mo-Hf compositions has indicated an optimized range of composition for the clad alloy. Compositional ranges studied include: (17.5-21.5)Cr; (5.0-6.5)Al; (0.09-2.50)Hf; and (0-1.0)Mo. Within the ranges studied, only Hf content showed any marked effect on oxide adherence, with both upper and lower limits being established. Chromium content was defined by both corrosion resistance and mechanical property considerations. Mechanical property data indicates that the Cr level should be less than 19% to obtain a low ductile-to-brittle transition temperature (DBTT), while corrosion resistance is reduced if the Cr content falls below about 18%. No effect of Al variations on corrosion or mechanical properties was observed for the composition range studied. Molybdenum also had no apparent effect on corrosion resistance or low temperature ductility. However, addition of Mo increased the hot strength of the alloy and may be beneficial in improving roll-bonding. The compositional ranges established for the optimum cladding alloy are as follows: (18.0-18.5)Cr-(5.5-6.5)Al-(0.9-1.1)Mo-(0.5-0.7)Hf- < 0.15Si- < 0.15Mn- < 0.02C-Bal.Fe.

38375 (PNL—3344) Air oxidation and seawater corrosion of Hastelloy S and Hastelloy C-4. Fullam, H.T. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Mar 1980. Contract AC06-76RL01830. 75p. NTIS, PC A04/MF A01.

A program is currently under way at the Pacific Northwest Laboratory (PNL) to develop the data and technology needed to permit the licensing of $^{90}SrF_2$ as a radioisotope heat source fuel for terrestrial applications. The WESF $^{90}SrF_2$ storage capsule consists of a Hastelloy C-276 inner capsule (2 in. I.D. x 19 in. long) and a 316L stainless steel outer capsule (2-3/8 in. I.D. x 20 in. long). Preliminary experimental tests and theoretical calculations show that the WESF storage capsule is incapable of meeting current licensing requirements for heat sources that are to be used for terrestrial applications. Therefore, the DOE decision was to develop a new heat source design that would retain the existing WESF Hastelloy C-276 inner capsule and replace the current WESF outer capsule with a new outer capsule capable of meeting current licensing requirements. Based on a number of factors, Hastelloy S was selected as the outer capsule material. Hastelloy C-4 was selected as a backup material in case the Hastelloy S had to be rejected for any reason. This report summarizes the results of studies carried out to determine the effects of both air oxidation at heat source operating temperatures and seawater corrosion on the tensile properties of the outer capsule materials.

38376 Characterization of high temperature gaseous environments. Kane, R.H. (Inco Inc, Suffern, NY). *Corrosion;* **36**: No. 3, 112-118(Mar 1980).

The object of much laboratory testing in high temperature gaseous environments is to simulate actual service conditions by duplicating the atmospheres in a thermodynamic sense. This is accomplished by generating similar oxidation, carburization and/or sulfidation potentials in laboratory tests which alloys may be expected to encounter in real processes. In this paper, atmospheres found in ethylene furnaces, steam reformers, high temperature helium cooled nuclear reactors, coal gasification reactors, and combustion systems were analyzed by the Brinkley method. 12 refs.

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 38910, 39184

CERAMICS, CERMETS, AND REFRACTORIES

REFER ALSO TO CITATION(S) 38321, 38541

PREPARATION AND FABRICATION

38377 (DOE/ET/15359—1) **Joining of ceramics for high performance energy systems. Mid-term progress report, August 1, 1979-March 31, 1980.** Smeltzer, C.E.; Metcalfe, A.G. (Solar Turbines International, San Diego, CA (USA)). 6 Oct 1980. Contract AC22-79ET15359. 39p. NTIS, PC A03/MF A01.

The subject program is primarily an exploratory and demonstration study of the use of silicate glass-based adhesives for bonding silicon-base refractory ceramics (SiC, Si_3N_4). The projected application is 1250 to 2050°F relaxing joint service in high-performance energy conversion systems. The five program tasks and their current status are as follows. Task 1 - Long-Term Joint Stability. Time-temperature-transformation studies of candidate glass adhesives, out to 2000 hours simulated service exposure, are half complete. Task 2 - Environmental and Service Effects on Joint Reliability. Start up delayed due to late delivery of candidate glass fillers and ceramic specimens. Task 3 - Viscoelastic Damping of Glass Bonded Ceramics. Promising results obtained over approximately the same range of glass viscosity required for joint relaxation function (10/sup 7.5/ to 10/sup 9.5/ poise). Work is 90% complete. Task 4 - Crack Arrest and Crack Diversion by Joints. No work started due to late arrival of materials. Task 5 - Improved Joining and Fabrication Methods. Significant work has been conducted in the area of refractory preglazing and the application and bonding of high-density candidate glass fillers (by both hand-artisan and slip-spray techniques). Work is half complete.

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 38129, 38204, 38322, 38366

38378 (DP-MS—80-79) **Failure mechanisms for compacted uranium oxide fuel cores.** Berghaus, D.G.; Peacock, H.B. (Savannah River Ecology Lab., Aiken, SC (USA)). 1980. Contract AC09-76SR00001. 12p. (CONF-801029—1). NTIS, PC A02/MF A01.

From Conference on high performance materials by powder metallurgy; Bristol, UK (27 Oct 1980).

Tension, compression, and shear tests were performed on test specimens of aluminum-clad, compacted powder fuel cores to determine failure mechanisms of the core material. The core, which consists of 70% uranium oxide in an aluminum matrix, frequently fails during post-extrusion drawing. Tests were conducted to various strain levels up to failure of the core. Sections were made of tested specimens to microscopically study initiation of failure. Two failure modes wee observed. Tensile failure mode is initiated by prior tensile failure of uranium oxide particles with the separation path strongly influenced by the arrangement of particles. Delamination mode consists of the separation of laminae formed during extrusion of tubes. Separation proceeds from fine cracks formed parallel to the laminae. Tensile failure mode was experienced in tension and shear tests. Delamination mode was produced in compression tests.

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 37465, 37716, 38204

38379 **Proton NMR in a hydrogen molybdenum bronze.** Cirillo, A.C. Jr.; Ryan, L.; Gerstein, B.C.; Fripiat, J.J. (Centre National de la Recherche Scientifique, CROSCI, 1B rue de la Ferollerie 45045, Orleans Cedex, France). W-7405-ENG-82. *J. Chem. Phys.;* **73**: No. 7, 3060-3068(1 Oct 1980).

Solid state nuclear magnetic resonance (NMR) has been used to probe the nature of hydrogen in the hydrogen bronze H/sub 1.64/ MoO_3. The line shape of the proton NMR at room temperature is found to be associated only with shielding anisotropy. Below 230 K, dipolar interactions become important in broadening the line. The response of the protons under a magic angle spinning experiment indicates that there is predominantly only one type of hydrogen in this sample. The shielding anisotropy indicates that at room temperature this species is not a hydroxyl proton. The longitudinal relaxation time of protons in this material exhibits a minimum between 190—320 K indicating that dipolar interactions modulated by motion are responsible for T_1 relaxation. Comparison of longitudinal relaxation times of partially deuterated and nondeuterated samples indicates that there exists a contribution to T_1 relaxation not dependent upon interproton distance. There does not appear to be a conduction electron contribution to the proton T_1.

CORROSION AND EROSION

REFER ALSO TO CITATION(S) 38256

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 38547

POLYMERS AND PLASTICS

REFER ALSO TO CITATION(S) 38103, 38104, 38524

PREPARATION AND FABRICATION

38380 **Sticky foam.** Rand, P.B. (to Dept. of Energy). US Patent 4,202,279. 13 May 1980. Filed date 12 Sep 1977. 6p.

PAT-APPL-832,488.

Access to a space is impeded by the generation of a sticky foam from a tacky polymeric resin and a low boiling solvent. Suitable resins are a thermoplastic resin comprising a blend of styrene/butadiene copolymer and polyindene, a styrene - isoprene thermoplastic elastomer, a polyterpene, and elastomeric resin, and a polyisobutylene resin. Low boiling solvents that are particularly suitable for use are dichlorodifluoromethane, methyl chloride, or dimethyl ether. (BLM)

38381 **Epoxy fiberglass tension member support for superconducting magnets.** Niemann, R.C. (Argonne National Lab., IL); Gonczy, J.D.; Mataya, K.F.; Smelser, P. *Adv. Cryog. Eng.;* **24**: 283-289(1978).

As the state of the art of superconducting magnet system design advances, an accompanying challenge is the minimization of the heat leak to the magnet cold mass. Accordingly, a criterion to be applied is to achieve the condition where the heat transfer by the supports, thermal radiation, and penetrations produces only the amount of gas flow required to cool the magnet current leads. This paper describes one component of the solution to the problem, a low-heat-leak structural support system.

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 38460

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 38366

38382 (SAND—80-1806) **Tensile testing of nylon and Kevlar parachute materials under Federal specified temperature and relative humidity conditions.** Botner, W.T. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 19p. NTIS, PC A02/MF A01.

A small 10-ft x 12-ft temperature and relative humidity controlled room for tensile testing of parachute materials is presented. Tensile tests of nylon and Kevlar parachute materials indicate there is a negligible change in break strength of test samples soaked in the controlled environment vs samples soaked in ambient conditions.

38383 **Rate-dependent criterion for crack growth.** Christensen, R.M. (Univ. of California, Livermore). Contract W-7405-ENG-48. *Int. J. Fract.;* **15**: No. 1, 3-21(Feb 1979).

The Griffith instability criterion for crack propagation is generalized to provide a criterion for time-dependent crack growth. Our procedure is similar to that of Griffith in its use of a global energy balance. The Griffith method is generalized by the inclusion of the rate-of-energy dissipation term in the balance law. This rate-of-dissipation term is derived to represent the behavior of viscoelastic materials; thus the final results are applicable primarily to polymeric behavior. Our final results are concise analytical expressions for crack velocity as a function of the creep properties of the material, the level of loading, and the energy or work content of the crack-generated new surface. These analytical solutions are quite general; the primary restriction occurs because they are derived under asymptotic conditions of high- and low-crack velocities. Finally, we compare the analytical predictions with experimental results for a polyurethane elastomer.

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 38381

OTHER MATERIALS

PREPARATION AND MANUFACTURE

REFER ALSO TO CITATION(S) 37816, 37817, 37818, 37820, 37821, 37825, 37827, 37829

38384 **Growth of $CuInSe_2$ by molecular beam epitaxy.** Grindle, S.P.; Clark, A.H.; Rezaie-Serej, S.; Falconer, E.; McNeily, J.; Kazmerski, L.L. (University of Maine at Orono, Orono, Maine 04469). *J. Appl. Phys.;* **51**: No. 10, 5464-5469(Oct 1980).

We have used molecular beam epitaxy to grow $CuInSe_2$ layers on CdS (0001B) and other substrates. Epitaxial growth is obtained at a substrate temperature of 300 °C. The ratio of the arrival rates of copper to indium is the key parameter governing layer stoichiometry. In order to produce low-resistivity p-type layers, the Cu/In arrival rate ratio must be slightly higher than that used to grow nominally stoichiometric layers. This suggests that a different defect is controlling electrical properties, rather than the copper vacancy complex which dominates bulk material. We have fabricated $CuInSe_2$/CdS heterojunctions which show a maximum solar conversion efficiency of ~5%.

38385 **Reciprocating pellet press.** Jones, C.W. (to Dept. of Energy). US Patent Application 110,143. 7 Jan 1980. 24p.

A machine for pressing loose powder into pellets using a series of reciprocating motions has an interchangeable punch and dies as its only accurately machines parts. The machine reciprocates horizontally between powder receiving and pressing positions. It reciprocates vertically to press, strip and release a pellet.

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 37828

38386 **Lattice dynamics of commensurate and incommensurate K_2SeO_4.** Axe, J.D.; Iizumi, M.; Shirane, G. (Brookhaven National

Laboratory, Upton, New York 11973). *Phys. Rev., B: Condens. Matter;* **22**: No. 7, 3408-3413(1 Oct 1980).

K_2SeO_4 undergoes an incommensurate structural transformation at $T_0 = 128$ K followed by a commensurate "lock-in" transformation at T/sub c/=93 K. Below T_0, the soft-phonon mode associated with the transformation is "split" into modes representing fluctuations in amplitude and phase of the complex order parameter. We have studied the dispersion and temperature dependence of these modes at T < or = 118 K. We have also seen intensity anomalies which can be explained by interactions between a transverse-acoustic-phonon branch and the low-lying "phason" branch.

38387 Theoretical equation of state for methane. Kerley, G.I. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *J. Appl. Phys.;* **51**: No. 10, 5368-5374(Oct 1980).

A theoretical equation of state for methane is derived and compared with experimental data. The EOS for the solid phase was constructed from the Debye model. The EOS for the fluid phase was constructed from thermodynamic perturbation theory. Tables of the calculated thermodynamic properties are available for temperatures from 20 to 10^4 K and for densities up to 2.5 g/cm^3. Agreement with experiment is good.

38388 Temperature-dependent small-angle x-ray scattering from poly(vinylidene fluoride). Schultz, J.M.; Lin, J.S.; Hendricks, R.W.; Lagasse, R.R.; Kepler, R.G. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26; DE-AC04-76-DP00789. *J. Appl. Phys.;* **51**: No. 10, 5508-5512(Oct 1980).

X-ray scattering measurements over the angular range 2—30 mrad are reported for a uniaxially oriented poly(vinylidene fluoride) film containing the phase I crystal polymorph. Each intensity profile exhibits at ~10 mrad an interference peak arising from quasiperiodic variation in electron density between crystalline and amorphous phases of the polymer. Over the temperature range 25—72 °C, reversible changes of 23% in peak intensity and 6% in peak position are observed. These reversible changes in x-ray scattering are analyzed in terms of a one-dimensional stack of alternating crystalline and amorphous layers. These model calculations show that the observed changes in the interference peak cannot be explained solely by thermal expansion within the two phases. In accordance with previous studies on other semicrystalline polymers, this discrepancy between observed scattering results and the predictions for thermal expansion is taken to be evidence that the crystallinity changes reversibly over the investigated temperature range. This evidence for reversible crystal melting is consistent with a hypothesis proposed by Kepler and Anderson to explain the pyroelectric response of polarized, phase I poly(vinylidene fluoride) films.

38389 Experimental study of the influence of temperature on a hydrogen-bonded system: the crystal structure of γ-glycine at 83 K and 298 K by neutron diffraction. Kvick, A. (Uppsala Univ. (Sweden)); Canning, W.M.; Koetzle, T.F.; Williams, G.J.B. (Brookhaven National Lab., Upton, NY (USA)). *Acta Crystallogr., Sect. B;* **36**: No. 1, 115-120(15 Jan 1980).

Neutron diffraction studies of γ-glycine, $C_2H_5NO_2$, have been carried out at 83 K and 298 K using the same crystal. Intensities of 2235 (83 K) and 1425 (298 K) reflections were measured at the Brookhaven National Laboratory High Flux Beam Reactor and the structures were refined by full-matrix least-squares techniques to yield final agreement factors of R(F²)sub(83K)=0.024 and R(F²)sub(298K)=0.025. The crystal was assigned space group $P3_2$ with a cell of dimensions: a=7.046 (3), c=5.491 (2) A at 298 K and a=6.975 (2), c=5.473 (2) A at 83+-0.5 K. The observed thermal parameters have been analyzed according to a general rigid-body model in order to study the effect of cooling on the molecular dimensions and on the thermal motion of the atoms. Large differences in the hydrogen-bond distances were found. The N...O hydrogen-bond lengths were observed to be 0.02-0.05 A longer at room temperature than at 83 K. These differences are accompanied by substantial changes in the lattice constants. The a and b axes contract more upon cooling than does the c axis, and this observation may be related to the fact that the largest principal axis of libration of the molecules lies nearly along c.

38390 Crystal and molecular structure of 1,1'-ferrocenedicarboxylic acid (triclinic modification): neutron and X-ray diffraction studies at 78 K and 298 K. Takusagawa, F.; Koetzle, T.F. (Brookhaven National Lab., Upton, NY (USA)). *Acta Crystallogr., Sect. B;* **35**: No. 12, 2888-2896(15 Dec 1979).

The crystal structure of the triclinic modification of 1,1'-ferrocenedicarboxylic acid, $C_{12}H_{10}FeO_4$, $[Fe(eta^5C_5H_5O_2)_2]$, has been determined from X-ray diffraction data measured at room temperature (298 K). Refinements based upon neutron diffraction data measured at a temperature of 78 K have provided a highly precise model. Crystal data: space group $P\bar{1}$, Z=4, a=7.424 (2), b=7.809 (2), c=18.118(4) A, α=98.79 (2), β=91.07 (2), γ=97.21 (3)° at T=78 K. For the neutron diffraction data, the final unweighted R value based on F² is 0.043 for 3856 unique reflections, and all bond distances have been determined to better than 0.003 A. The structure is composed of hydrogen bonded dimers, each related internally by a center of inversion, and there are two crystallographically independent dimers per unit cell. The C and H atoms attached to the cyclopentadienyl rings are displaced significantly out of the ring planes toward the Fe atoms [mean displacement = 0.030 (4) A]. The major difference between the 1,1'-ferrocenedicarboxylic acid molecules in the triclinic and monoclinic modifications concerns the positions of the acidic protons. In the triclinic form, the protons are ordered, while in the monoclinic form, they are equally distributed over two sites displaced approximately symmetrically from the midpoint of the O...O hydrogen bonds.

38391 Pressure induced strain transition in NiF_2. Jorgensen, J.D. (Argonne National Lab., IL); Worlton, T.G.; Jamieson, J.C. pp 152-160 of High-pressure science and technology. Volume 1. Timmerhaus, K.D.; Barber, M.S. (eds.). New York, NY; Plenum Publishing Corporation (1979).

Recent high-pressure elastic-constant measurements on NiF_2 have shown decreases with increasing pressure to 1.0 GPa, suggesting the possibility of a phase transition at some higher pressure. Subsequent x-ray measurements confirmed that a tetragonal to orthorhombic transition does occur at elevated pressures. However, they found the orthorhombic strain to be small that doublets were resolved only above 4.0 GPa. Using time-of-flight neutron diffraction, the transition is shown to be continuous and occurs at 1.83 +- 0.1 GPa and the high-pressure phase is orthorhombic Pnmm. The latter is a subgroup of $P4_2/mnm$ and is consistent with a second-order strain transition involving a soft-transverse acoustic-phonon mode propagating along <110> and polarized along <110> [11,12].

PROPERTIES

REFER ALSO TO CITATION(S) 37828, 37835, 38029, 38517

38392 (UCRL—50025-80-1, pp 17-20) **Compressed hydrogen becomes electrically conducting at megabar pressures.** 1 Apr 1980.

In Electronics Engineering Department. Quarterly report No. 1, 1980.

The electrical conductivities of hydrogen and neonduring isentropic compresssion in a magnetic-flux compression device are measured. Hydrogen becomes conducting at a density of about 1.06 g/cm^3 and at a calculated pressure of about 200 GPa(2 Mbar). Neon remained an insulator to an estimated pressure of more than 500 GPa (5 Mbar).

38393 Hygrothermomechanical characterization of polyvinyl acetate. Knauss, W.G.; Kenner, V.H. (Graduate Aeronautical Laboratories, California Institute of Technology, Pasadena, California 91125). 49-767-1D002-0-3460. *J. Appl. Phys.;* **51**: No. 10, 5131-5136(Oct 1980).

As a part of a program to understand the mechanisms of failure in time-dependent adhesion and film bonding, the creep compliance of polyvinyl acetate (PVAc) in shear has been determined both as a function of temperature and absorbed moisture. Volumetric expansion as a function of temperature or moisture takeup was also measured. We find that practically realizable changes in moisture content affect both the creep compliance and the swelling of PVAc to a degree comparable to that resulting from realistic changes in temperature. For example, the creep rates (histories) at corresponding times for PVAc subjected to 92% relative humidity storage are accelerated by approximately four orders of magnitude over those found for the dry material. Moreover, we find within reasonable experimental error that water concentration affects the time scale of creep like temperature through a concentration-dependent shift factor. An attempt is made at discussing the interrelation of temperature- and moisture-induced volume changes.

38394 Infrared reflectivity and transmissivity of boron-implanted, laser-annealed silicon. Engstrom, H. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26;. *J. Appl. Phys.;* **51**: No. 10, 5245-5249(Oct 1980).

Analysis of the infrared reflectance and transmittance of boron-implanted, laser-annealed silicon shows that the Drude theory of free hole scattering provides a good description of the optical properties of these materials up to the highest doping levels obtainable. It was found that (1) the relaxation time ($\sim 7 \times 10^{-15}$ s) was independent of the implant dose, and (2) the boron concentration affecting the optical properties varies essentially linearly with implant dose.

38395 Effectiveness of SiO_2 for preventing silicon -metal reactions at high temperatures. Bevolo, A.J.; Campisi, G.J.; Shanks, H.R.; Schmidt, F.A. (Ames Laboratory, Iowa State University, Ames, Iowa 50011). WPAS-KC-02-01-01; WPAS-KC-02-02-02. *J. Appl. Phys.;* **51**: No. 10, 5390-5395(Oct 1980).

Silicon dioxide layers, deposited by rf sputtering and measuring less than 1000 A thick, were found to prevent silicide formation between evaporated silicon films and molybdenum substrates after

annealing for 1 h at 1250 °C. Silicon grain size ranged from 0.2 to 2.5 μ in cross section. In situ Auger electron spectroscopy (AES) was used in the silicon deposition chamber to monitor the heat treated $Si/SiO_2/Mo$ samples for silicide formation. Composition depth profiling by ion beam sputtering and AES analysis was used to measure oxygen diffusion into the silicon and metal phases. This technique established that the breakdown of SiO_2 as a reaction barrier between the molybdenum and silicon occurred because of oxygen diffusion from the SiO_2 layer into the silicon. A similar behavior is expected between SiO_2 and tungsten. However, when SiO_2, deposited on tantalum, was heated to 1100 °C, the oxygen was found to have migrated into the metal resulting in the breakdown of the oxide layer.

38396 Effect of mismatch on the performance of GaAsSb photodiodes. Moon, R.L. (Corporate Solid State Laboratory, Varian Associates, Inc., Palo Alto, California 94303). EY-76-C-03-1250. *J. Appl. Phys.;* **51**: No. 10, 5561-5564(Oct 1980).

The maximum quantum efficiency of GaAs/sub 1-x/Sb/sub x/ photodiodes with $0.03 < x < 0.11$ is shown to decrease as the lattice mismatch between the epitaxial layers and the GaAs (100) substrate increases. Dislocations arising from the mismatch are responsible, but these can be reduced and the performance improved by step-grading. The performance decrease with increasing dislocation density follows the equation developed by Roedel et al., and with this equation an estimate of the performance decrease with mismatch is obtained when the experimental data for dislocation density versus mismatch is used.

38397 Novel measurement of hyperfine interactions in solids: $^{207}Pb^{3+}$ in YPO_4 and $LuPO_4$. Abraham, M.M.; Boatner, L.A.; Rappaz, M. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *Phys. Rev. Lett.;* **45**: No. 10, 839-842(8 Sep 1980).

Stable trivalent lead impurities have been observed at room temperature in "flux-grown" single crystals of YPO_4 and $LuPO_4$ by electron paramagnetic resonance. Because of a fortuitous set of circumstances, a unique measurement of the hyperfine constant of $^{207}Pb^{3+}$ in these materials was possible. The resulting values are the largest ever observed for the trivalent lead ion in a solid. A super hyperfine interaction with ^{31}P neighbors has also been measured and, surprisingly, this interaction is larger for the second ^{31}P neighbors than for the first ^{31}P neighbors.

38398 Contamination and reverse contamination at low temperatures. Voreades, D.; Wall, J.S. (Brookhaven National Lab., Upton, NY). pp 358-359 of Thirty-seventh annual proceedings of the Electron Microscopy Society of America. Bailey, G.W. (ed.). San Antonio, TX; Electron Microscopy Society of America (1979).

As a result of contamination in the electron microscope, one can see a gradual buildup of a layer on the surface of the specimen, as the electron beam strikes it. Many different methods are employed to reduce contamination. It is common practice among electron microscopists to pre-irradiate the specimen. Baking was suggested at 100°C in vacuum prior to observation. An Argon jet was used to blow away the contaminants. Cooling was suggested. The question, however, is how the surface migration of the contaminants is affected by employing any method that reduces contamination. And this is best answered by studying the surface migration itself and determining the parameters involved.

CHEMISTRY

38399 (ORNL—5665) **Chemistry Division annual progress report, February 29, 1980.** (Oak Ridge National Lab., TN (USA)). Jul 1980. Contract W-7405-ENG-26. 218p. NTIS, PC A10/MF A01.

Separate abstracts were prepared for 12 of the 13 sections of this report. The remaining section, Chemistry In Support of the Nuclear Fuel Cycles, is very brief. (DLC)

ANALYTICAL AND SEPARATIONS CHEMISTRY

38400 (HASL—300(Suppl.8)) **HASL procedures manual.** (Department of Energy, New York (USA). Environmental Measurements Lab.). Aug 1980. 43p. NTIS, PC A03/MF A01.

Addition and corrections to the following sections of the HASL Procedures Manual are provided: Table of Contents; Bibliography; Fallout Collection Methods; Wet/Dry Fallout Collection; Fluoride in Soil and Sediment; Strontium-90; Natural Series; Alpha Emitters; and Gamma Emitters. (LK)

38401 (ORNL/CSD/TM—81) **Analytical Chemistry Division's sample transaction system.** Stanton, J.S.; Tilson, P.A. (Oak Ridge National Lab., TN (USA)). Oct 1980. Contract W-7405-ENG-26. 85p. NTIS, PC A05/MF A01.

The Analytical Chemistry Division uses the DECsystem-10 computer for a wide range of tasks: sample management, timekeeping, quality assurance, and data calculation. This document describes the features and operating characteristics of many of the computer programs used by the Division. The descriptions are divided into chapters which cover all of the information about one aspect of the Analytical Chemistry Division's computer processing.

38402 (UCRL—15287) **Investigation of methods to characterize nonlinear chemistry systems of large and small dimension. Final report, October 1, 1978-September 30, 1979.** Brubaker, T.A. (Colorado State Univ., Fort Collins (USA); California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Apr 1980. Contract W-7405-ENG-48. 120p. NTIS, PC A06/MF A01.

Work focused on two areas, the ion selective electrode project and the automation in surface chemistry. The report deals with the following topics: (1) linear and nonlinear parameter estimation for estimating the equivalence point in potentiometric titrations using ion selective electrodes; (2) two dimensional polynomial filtering for surface smoothing; and (3) automation in surface chemistry.

ACTIVATION AND NUCLEAR REACTION PROCEDURES

REFER ALSO TO CITATION(S) 37503, 37507, 37676, 37682, 37756, 38665

38403 Determination of carbon in atmospheric aerosols by deutron activation analysis. Clemenson, M.; Novakow, T.; Markowitz, S. (Univ. of California, Berkeley). *Anal. Chem.;* **52**: No. 11, 1758-1761(Sep 1980).

Nuclear reactions induced by 7.6-MeV deuterons are used to determine total carbon in atmospheric aerosols. The ^{12}C-(d,n) ^{13}N reaction produces the radionuclide ^{13}N, a 10.0-min positron emitter, which is detected by its 0.511-MeV annihilation radiation. The detection system is a Ge(Li) γ-ray spectrometer. The method is nondestructive of the sample, permitting the sample to be studied by additional methods. Comparison of carbon found by deuteron activation analysis with that found by independent but destructive combustion methods shows a standard deviation of 10% for 15 samples analyzed over a wide range of carbon contents. The detection limit is estimated to be 0.5 $\mu g/cm^2$, corresponding to a carbon concentration of 0.2% in a sample of total thickness 250 $\mu g/cm^2$.

38404 Interlaboratory comparison of arsenic, molybdenum and selenium analyses from uranium mill tailings. Dreesen, D.R.; Gladney, E.S.; Owens, J.W. (Los Alamos Scientific Lab., NM). *J. Water Pollut. Control Fed.;* **51**: No. 10, 2447-2456(Oct 1979).

In order to evaluate the analytical results coming from various laboratories on water samples analyzed for leached elements from uranium mill tailings piles or ponds, groundwater samples were collected from wells on top of and hydrologically downgradient from tailings piles produced by a uranium mill using a carbonate leach process. These samples were spiked with As, Mo, and Se at levels of 500 μg/l, 250 μg/l, and 500 μg/l, respectively, and submitted to various laboratories for analysis. The various methods used by the different laboratories for the analyses were broadly categorized as follows: flameless atomic absorption, flame atomic absorption, hydride generation flame atomic absorption, spectrophotometric-calorimetric, instrumental neutron activation analysis, neutron activation analysis with radiochemical separation, x-ray fluorescence spectroscopy, and fluorimetry. For comparison, the results of the different analyses for each element are tabulated. It was concluded that the wide spectrum of laboratories provide questionable data for trace elements in complex matrixes. It was felt that much improvement of methods and better understanding of the complexities of the matrixes are necessary before results of analyses are available on which to base judgments concerning the environmental pollution by these elements, particularly Se. (BLM)

CHEMICAL PROCEDURES

REFER ALSO TO CITATION(S) 37662, 37756, 38639

38405 (DOE/ER/10554—T1) **Development and optimization of methodologies for analysis of complex hydrocarbon mixtures. Summary of progress, 1 January-31 August, 1980.** Laub, R.J. (Ohio State Univ., Columbus (USA). Dept. of Chemistry). 1980. Contract AC02-80ER10554. 12p. NTIS, PC A02/MF A01.

This progress report describes studies designed to explore and to clarify the a priori prediction of optimum conditions for the chromatographic separation of complex mixtures of organic compounds of significance to the Department of Energy.

38406 (UCID—18715) **Effect of fluoride, chloride, bromide, and thiocynate on potentiometric titrations of iron(II)-tin(II) mixtures with cerium(IV).** Kwok, Y.M. (California Univ., Livermore (USA). Law-

rence Livermore Lab.). 31 Jul 1980. Contract W-7405-ENG-48. 24p. NTIS, PC A02/MF A01.

A two-step curve is expected in the potentiometric titration of Fe(II)-Sn(II) mixtures with Ce(IV) in H_2SO_4. Each end point should indicate the respective oxidation of Sn(II) and Fe(II). However, experimentally only one end point was found; it corresponded to the total oxidation of Sn(II) and Fe(II). When this oxidation-reduction reaction was carried out in the presence of Cl^-, the theoretical behavior was observed. The present study was done to ascertain if monovalent anions other than Cl^- have a similar effect on this oxidation-reduction system. The monovalent species F^-, Br^-, and SCN^- were selected for this study, and the results indicate that each affects the rate of reaction relative to the ease of oxidation of the individual ions.

38407 Assay of ammonium nitrate and ethylenediamine dinitrate. Selig, W. (Univ. of California, Livermore). Contract W-7405-ENG-48. *Propellants Explos.;* **4**: 50-52(1979).

Ammonium nitrate and ethylenediamine dinitrate in a composite have been determined by potentiometric titration with standard base after reaction with formaldehyde. Ethylenediamine dinitrate yield two breaks, while ammonium nitrate exhibits only a single potentiometric break. Both components can therefore be resolved. The first potentiometric break is a measure of the ethylenediamine dinitrate content, while the second break is a measure of the sum of the components.

RADIOMETRIC AND RADIOCHEMICAL PROCEDURES

REFER ALSO TO CITATION(S) 37725, 37751, 37756, 38404, 38713

38408 Simultaneous determination of zirconium and hafnium in solutions by x-ray fluorescence spectrometry. Ricci, E. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Anal. Chem.;* **52**: No. 11, 1708-1710(Sep 1980).

The importance of Zr and Hf in nuclear reactor research and development is well established. A reliable x-ray fluorescence method (XRF) was developed to determine these two elements simultaneously in (0.5-1.0 M H_2SO_4) solutions at levels ranging from 0.5 to 200 ppM. Handling of serial samples is enabled by a 90-sample changer and by the simple chemistry involved. Ferric hydroxide is precipitated with ammonia in a test tube. After washing, the $Fe(OH)_3$ slurry containing all the $Zr(OH)_4$ and $Hf(OH)_4$ is transferred to a 6.4 μm thick Mylar mount where it is quickly dried on a steam bath. These mounts are inexpensive, hold well during drying, and provide a < 1 mg/cm^2 thick sample for low-scattering measurements. Fluorescence Zr Kα and Hf Lβ_1 x-rays are excited by a Ag-anode tube (40 kV-14 mA). The method is based on comparison of multileast-squares results from sample and standard spectra. It is reliable and fast and has an accuracy of 5 to 10%, with detection limits of 0.4 ppM for Zr and 1.2 ppM for Hf.

SPECTRAL PROCEDURES

REFER ALSO TO CITATION(S) 37508, 37662, 38404, 38417, 38453

38409 Fourier transform photoacoustic visible spectroscopy of solids and liquids. Lloyd, L.B. (Univ. of Utah, Salt Lake City); Burnham, R.K.; Chandler, W.L.; Eyring, E.M.; Farrow, M.M. *Anal. Chem.;* **52**: No. 11, 1595-1698(Sep 1980).

Fourier transform photoacoustic spectroscopy (FTPAS) can be carried out in the visible using either a piezoelectric crystal or a microphone to detect the interferogram produced in a sample when the latter is illuminated by white light passed through a Michelson interferometer. Spectra of lanthanide oxides and whole human blood are reported that illustrate benefits and limitations of visible FTPAS.

38410 Determination of silicon in thin-film aluminum on a silicon substrate. Tallant, D.R. (Sandia National Labs., Albuquerque, NM). Contract AC04-76-DP00789. *Anal. Chem.;* **52**: No. 11, 1780-1781(Sep 1980).

One aspect of microelectronics fabrication technology involves metallization of integrated circuits with a thin layer (1 μm) of aluminum containing a small amount of silicon, which helps prevent diffusion of the aluminum into the substrate. Quality control of the metallization process necessitated development of a technique for the determination of silicon (0 to 3 wt %) in a thin aluminum layer on a silicon substrate. Emphasis was therefore placed on developing a wet chemical technique by which the thin aluminum films could be selectively etched without sampling the silicon substrate and by which the 5 to 150 μg of solubilized silicon could be reliably determined. By depositing a thin coating of silicon nitride on the silicon substrate prior to the deposition of the silicon-containing aluminum film, a chemically-resistant (i.e., passive) substrate was formed from which the aluminum layer could be selectively etched. The aluminum film is then etched with sodium hydroxide. In the silicon determination procedure the etched solution is first acidified with hydrochloric acid, and ammonium molybdate solution is added to form silicomolybdic acid $H_4SiO_4(MoO_3)_{12}$, which is extracted into 1-butanol. The organic phase is then analyzed for the 12 molybdate atoms associated with each silicon atom by flame atomic absorption spectrometry. Over a hundred samples were analyzed for silicon by the above procedure and the silicon content was found to range from 8 μg to 130 μg.

38411 Heating profile curves for resistively heated filament pyrolyzers. Wells, G.; Voorhees, K.J.; Futrell, J.H. (Univ. of Utah, Salt Lake City). Contract A2079LC10030. *Anal. Chem.;* **52**: No. 11, 1782-1784(Sep 1980).

Results from an extensive investigation of heating profiles for the commercially available chemical data system pyroprobe filament pyrolyzer are summarized. The authors' results were quite different from those anticipated from the manufacturer's literature.

38412 Method and apparatus for optoacoustic spectroscopy. Amer, N.M. (to Dept. of Energy). US Patent 4,163,382. 7 Aug 1979. Filed date 28 Apr 1978. 8p.
PAT-APPL-901,048.

An apparatus that significantly increases the sensitivity and flexibility of laser optoacoustic spectroscopy with reduced size and a method for use of the apparatus are described. With the method, it no longer is necessary to limit the use of laser optoacoustic spectroscopy to species whose absorption must match available laser radiation. Instead, doping with a relatively small amount of an optically absorbing gas yields optoacoustic signatures of nonabsorbing materials (gases, liquids, solids, and aerosols), thus significantly increasing the sensitivity and flexibility of optoacoustic spectroscopy. Several applications of this method are demonstrated and/or suggested.

38413 Method and apparatus for continuously referenced analysis of reactive components in solution. Bostick, W.D.; Denton, M.S.; Dinsmore, S.R. (to Dept. of Energy). US Patent Application 062,375. 31 Jul 1979. 25p.

A continuously referenced apparatus for measuring the concentration of a reactive chemical species in solution comprises in combination conduit means for introducing a sample solution, means for introducing one or more reactants into a sample solution, and a stream separator disposed within the conduit means for separating the sample solution into a first sample stream and a second sample stream. A reactor is disposed in fluid communication with the first sample stream. A reaction takes place between the reactants introduced and the reactive chemical species of interest, causing the consumption or production of an indicator species in the first sample stream. Measurement means such as a photometric system are disposed in communication with the first and second sample streams, and the outputs of the measurement means are compared to provide a blanked measurement of the concentration of indicator species. The apparatus is particularly suitable for measurement of isoenzymes in body tissues or fluids.

SEPARATION PROCEDURES

REFER ALSO TO CITATION(S) 37548, 37661, 37663, 37694, 37719, 38089, 38795

38414 (ORNL—5665, pp 81-93) **Separations chemistry.** Jul 1980.
In Chemistry Division annual progress report, February 29, 1980.

Studied are: statistical thermodynamics of liquids, liquid crystals, and micelles (polymers), stability quotients of lanthanide cryptates, HPLC separation of Zr and Hf, recovery of U from wet-process phosphoric acid, and separations by filtrations. 10 figures. (DLC)

INORGANIC AND PHYSICAL CHEMISTRY

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 37784, 38044, 38495, 38933

38415 (DOE/ER/70218—T1) **Multiheteromacrocycles that complex metal ions. Sixth progress report, 1 May 1979-30 April 1980.** Cram, D.J. (California Univ., Los Angeles (USA). Dept. of Chemistry). 15 Jan 1980. Contract AT03-76ER70218. 19p. NTIS, PC A02/MF A01.

Objective is to design synthesize, and evaluate cyclic and polycyclic host organic compounds for their abilities to complex and lipophilize guest metal ions, their complexes, and their clusters. Host organic compounds consist of strategically placed solvating, coordinating, and ion-pairing sites tied together by covalent bonds through hydrocarbon units around cavities shaped to be occupied by guest metal ions or by metal ions plus their ligands. Specificity in complexation is sought by matching the following properties of host and guest: cavity and metal ion sizes; geometric arrangements of binding sites; number of binding sites; character of binding sites; and va-

lences. During this period, hemispherands based on an aryloxy or cyclic urea unit, spherands based on aryloxyl units only, and their complexes with alkali metals and alkaline earths were investigated. An attempt to separate ^{6}Li and ^{7}Li by gel permeation chromatography of lithiospherium chloride failed. (DLC)

38416 (DOE/EV/01515—81) **Calcium and zinc adsorption by iron hydrous oxide gel.** Kinniburgh, D.G.; Jackson, M.L. (Wisconsin Univ., Madison (USA)). 1980. Contract AS02-76EV01515. 20p. NTIS, PC A02/MF A01.

In the presence of 1M $NaNO_3$, freshly precipitated iron hydrous oxide gel suspensions (0.093M Fe) selectively adsorbed Ca and Zn over a wide concentration range. Adsorption was highly pH dependent, especially for Zn. For Ca, the pH at which 50% adsorption occurred, pH_{50}, varied from pH 7.15 at 2 x 10^{-6}M Ca (total) to pH 9.55 at 10^{-3}M Ca, whereas for Zn, the pH_{50} values varied from pH 5.00 at ~ 10^{-7}M Zn to pH 6.25 at 10^{-3}M Zn. Adsorption isotherms for Ca (pH 8.0) and Zn (pH 5.5 and 6.5) showed no adsorption maxima. With high Zn concentrations at pH 6.5, Zn precipitated as a separate, visible zinc hydroxide (or hydroxycarbonate) phase. At an equilibrium concentration of 10^{-7}M Zn, Fe gel adsorbed approximately 5 μg Zn/g at pH 5.5 and an estimated 240 μg Zn/g at pH 6.5 indicating that amorphous iron oxides retain small, but perhaps significant, quantities of Zn at realistic soil solution concentrations.

38417 (MLM—2751) **Surface studies on the thermite mixture of Al/Cu_2O. I. Auger and x-ray photoelectron results using Si K/sub α/ x-radiation.** Rengan, A.; Haws, L.D.; Moddeman, W.E.; Wang, P.S. (Mound Facility, Miamisburg, OH (USA)). 7 Oct 1980. Contract AC04-76DP00053. 53p. NTIS, PC A04/MF A01.

Thermite is the name given to a mixture of powdered aluminum and a metallic oxide. When a thermite mixture is ignited the chemical reaction proceeds very rapidly with a great evolution of heat, the temperature rising to around 2000°C. Uses for the thermite reaction have been found in metallurgy, in immobilizing radionuclides, and in military applications. The surface chemistry of the thermite materials, aluminum and copper powders, were examined with Auger and x-ray photoelectron spectroscopy also referred to as Electron Spectroscopy for Chemical Analysis (ESCA). This preliminary study was made to show the feasibility of ESCA in examining the surface chemistry of the thermite materials. The surface of the aluminum metal powder was found to be contaminated with an oxide. The oxide was characterized to be Al_2O_3, and the oxide layer was found to be approximately 20A. A zinc contamination layer, approximately 300A thick, was noted on the copper. The oxidized species on the copper powder was characterized to be $Cu(OH)_2$. The change in the binding energies and differences in the Auger parameter for aluminum and its oxide and copper and its oxides were substantial, making the ESCA technique useful in studying the Al/Cu_2O thermite.

38418 (MLM—2752) **Surface studies on the thermite mixture of Al/Cu_2O. II. Thickness measurements of carbon and of aluminum oxide on aluminum, and changes in copper chemistry.** Rengan, A.; Haws, L.D.; Moddeman, W.E.; Wang, P.S. (Mound Facility, Miamisburg, OH (USA)). 10 Oct 1980. Contract AC04-76DP00053. 33p. NTIS, PC A03/MF A01.

Improved surface analysis techniques of x-ray induced photoelectron spectroscopy (XPS) and high resolution Auger spectroscopy (AES) were used to study thermite materials. The thermite under examination was a powdered mixuture of aluminum metal and cuprous oxide in a mole ratio of 2/3. These improved techniques were used to examine the surfaces of the aluminum metal and of the cuprous oxide for the presence, the amount, and the thickness of contaminants. Carbon, aluminum oxide, cupric oxide, and metallic-like copper were found on the reactants and mixtures. XPS and AES spectra of aluminum and copper are given, and equations are derived which allow for the calculation of carbon and oxide thicknesses.

38419 (MLM—2753) **Surface studies on the thermite mixture of Al/Cu_2O. III. Scanning Auger microscopy of the consolidated pellet.** Wang, P.S.; Haws, L.D.; Moddeman, W.E. (Mound Facility, Miamisburg, OH (USA)). 14 Oct 1980. Contract AC04-76-DP00053. 26p. NTIS, PC A03/MF A01.

The outer and the fractured surfaces of hot-pressed Al/Cu_2O pellets were investigated by scanning Auger microscopy. The surface grain images and elemental pictures of aluminum and copper are illustrated. Auger spectra of the outer surface show the existence of carbon, chlorine, oxygen, and sodium as contaminants. Auger mapping of the grains gives a clear picture of the Cu_2O particles and the general continuum of the aluminum. These pictures compare well with scanning electron micrographs taken previously of similar Al/Cu_2O pellets. In-depth elemental profiling, by sputter-etching, illustrates that carbon, sodium, and chlorine are surface contaminants. The analysis of the fractured surface verified the presence of an interfacial region between the aluminum and Cu_2O of at least 100 A that was caused by the pelletization process at elevated temperatures.

38420 (ORNL—5665, pp 128-158) **Chemical physics.** Jul 1980. In Chemistry Division annual progress report, February 29, 1980.

Structural chemical topics studied included: superionic conductors (β" aluminas), tetrathiafulvalene triiodide, 2,3-bis (2-pyridyl) quinoxalene-1,1'-ruthenium (II) bis (2,2-bipyridyl) cation,nucleosomes, force constants of 1,3,5-triphenylbenzene, atom pair potentials of liquid N_2, neutron diffraction of liquid H_2O, and programmed reasoning. Topics in atomic and molecular collisions which were studied included: crossed-beam C + NO → CN + O, electron detachment from Cl^- by N_2, collisional dissociation of UF_6^-, coherent excitation of channeled N^{6+} and N^{5+} ions in (100) Au, radiation from channeled electrons and positrons in Si, angle-resolved photoelectron spectroscopy, electron spectrometry with synchrotron radiation, and photoionization of atomic Ag. Radicals formed in the pyrolysis of bibenzyl, cumene, and ethylbenzene were studied using ESR. 24 figures, 3 tables. (DLC)

38421 **Negative ion—uranium hexafluoride charge transfer reactions.** Streit, G.E.; Newton, T.W. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *J. Chem. Phys.;* **73**: No. 7, 3178-3182(1 Oct 1980).

The flowing afterglow technique has been used to study the process of charge transfer from selected negative ions (F^-, Cl^-, Br^-, I^-, SF_6^-) to UF_6. The sole ionic product in all cases was observed to be UF_6^-. Data analysis was complicated by an unexpected coupling of chemical and diffusive ion loss processes when UF_6^- product ions were present. The rate coefficients for the charge transfer processes are (k in 10^{-9} cm^3 $molecule^{-1}$ s^{-1}) F^-, 1.3; Cl^-, 1.1; Br^-, 0.93; I^-, 0.77; and SF_6^-, 0.69. The rate constants agree quite well with the classical Langevin predictions.

38422 **Structure and dynamic behavior of transition-metal ions in aqueous solution: an EXAFS study of electron-exchange reactions.** Sham, T.K.; Hastings, J.B.; Perlman, M.L. (Brookhaven National Lab., Upton, New York). *J. Am. Chem. Soc.;* **102**: No. 18, 5904-5906(27 Aug 1980).

From 178. National Meeting of the American Chemical Society; Washington, DC USA (Sep 1979).

The extended x ray absorption fine structure (EXAFS) phenomenon has become a powerful tool for structure determination in the immediate vicinity of an atom of identified Z. In this paper, the power of EXAFS for the study of kinetics and reaction mechanisms in solution are demonstrated. Of particular concern here are the metal-ligand bond distances and the associated Debye-Waller factors of $M(H_2O)_6$/sup n+/ complexes in aqueous solution. The metal-oxygen interatomic distances for Cr^{3+}, Cr^{2+}, Mn^{2+}, Fe^{2+}, Fe^{3+} and Cu^{2+} obtained by EXAFS are tabulated and compared with reference values of those obtained from solution x-ray scattering experiments and single crystal diffraction work. Although it appears that for these ions in solution the EXAFS r values are slightly smaller than those from diffraction measurements, the differences are within experimental error. With the bond lengths and Debye-Waller information obtained directly from ions in solution the parameters relevant to the kinetics of the electron-exchange reaction can be estimated. For $Fe(H_2)_6^{2+}$ and $Fe(H_2O)_6^{3+}$, the difference between the Fe to 0 radii of the two ions, $r^2 - r^3$ is the most critical parameter. The relationship connecting the EXAFS parameters and the electron-exchange reaction is shown mathematically. The Debye-Waller factor derived from the EXAFS data also contains important bonding information.

38423 **Effusion studies of the catalyzed decomposition of magnesium sulfate.** Knittel, D.R.; Lau, K.H.; Hildenbrand, D.L. (SRI International, Menlo Park, CA). *J. Phys. Chem.;* **84**: No. 15, 1890-1894(24 Jul 1980).

The effects of certain metal and metal oxide additives on the thermal decomposition of M/sub g/SO_4 have been investigated by the torsion-effusion method in the range 900 to 1000 K. Although the pure material yields SO_3 as the sole gaseous decomposition product, metals such as Pt, Ru, and Ir and the oxides Cr_2O_3, Mn_2O_3, Fe_2O_3, CoO, NiO, and CuO added at a level of a few mole % catalyze the decomposition process, yielding pressures and effusing gas compositions consistent with the equilibrium process $MgSo_4(s) = MgO(s) + SO_2(g) + 1/2\ O_2(g)$. Other additives ($TiO_2$, Y_2O_3, MgO, Al_2O_3, ZnO, and V_2O_4) were found to have little or no effect on $MgSO_4$ decomposition. The most effective catalysts seem to be those that have the greatest capacity for oxygen chemisorption and are generally good oxidation catalysts. Several of the catalyst parameters such as particle size and degree of loading have been investigated. All of the various results are consistent with a mechanism in which evolution of SO_3 is the primary step in the decomposition, and the additive simply catalyzes the conversion of SO_3 to SO_2 and O_2. The catalyzed and uncatalyzed decomposition pressure data are in agreement with a value of -310.2 +- 1.0 kcal/mol for the standard enthalpy of formation of $MgSO_4(s)$ at 298 K.

38424 Moessbauer and Raman spectra of carbon-supported iron phthalocyanine. Melendres, C.A. (Argonne National Lab., IL). *J. Phys. Chem.;* **84**: No. 15, 1936-1939(24 Jul 1980).

Moessbauer spectra have been obtained for iron phthalocyanine supported on high-surface-area carbon and prepared by the dissolution-precipitation technique. A number of isomer shifts (δ) and quadrupole interaction parameters (Δ) are observed, which, at high loadings ($\sim$ 45 % FePc), appear to be determined primarily by interaction with the solvent and atmospheric oxygen. At low loadings (<15 wt %), a quadrupole doublet (δ = 0.32, Δ = 0.66 mm/s) is observed which is attributed to interaction with the carbon substrate. Raman spectra taken at different exciting laser frequencies exhibit resonance enhancement. Significant differences are observed between the spectra of pure FePc and the carbon-supported FePc which provide further evidence of catalyst-support interaction.

38425 Solvation-shell geometry of copper ion in methanol and in acetone and a molecular picture of preferential solvation of copper ion by methanol in methanol-acetone mixed solvent determined by electron spin-echo modulation analysis. Ichikawa, T.; Kevan, L. (Wayne State Univ., Detroit MI). EY-76-S-02-2086. *J. Phys. Chem.;* **84**: No. 15, 1955-1958(24 Jul 1980).

Electron spin-echo modulation studies have been carried out for Cu^{2+} in CD_3OH, CH_3OD, and CD_3COCD_3 to deduce the cation solvation-shell geometry in these solvents. The results indicate that the Cu^{2+} is solvated by six molecules in both methanol and acetone with the molecular dipoles of these molecules oriented toward Cu^{2+}. The Cu^{2+} to nearest solvent molecule oxygen distance is 2.1 A for both solvents. In mixed solvents the basic solvation-shell geometry does not change, but methanol preferentially solvates Cu^{2+} in comparison with acetone. A quantitative study shows that the probability of finding methanol in the first solvation shell of Cu^{2+} is 78% more than statistical over the range of 9 to 40 mol % methanol in acetone. This constant probability suggests the absence of cooperative effects in the solvation process.

38426 Iron pentacarbonyl decomposition over grafoil. Production of small metallic iron particles. Phillips, J.; Clausen, B.; Dumesic, J.A. (Univ. of Wisconsin, Madison). Contract ET-78-G-01-3380. *J. Phys. Chem.;* **84**: No. 14, 1814-1822(10 Jul 1980).

Mossbauer spectroscopy was the principal technique used to study the adsorption and thermal decomposition of iron pentacarbonyl on a high surface area, oriented graphite (Grafoil). The iron carbonyl physisorbs on the graphite at temperatures less than ca. 300 K, whereas decomposition of the carbonyl occurs upon heating to 378 K. The Mossbauer spectra of the decomposition product are sextuplets indicative of metallic iron. However, the room-temperature magnetic hyperfine splitting (ca. 300 kOe) is smaller and the peak widths (ca. 1.5 mm s^{-1}) are larger than those corresponding spectral parameters for bulk metallic iron (330 kOe and 0.28 mm s^{-1}, respectively). Computer simulations suggest that these differences are due to magnetic relaxation and to a distribution of magnetic hyperfine fields. For consistency with the Mossbauer spectra, it is proposed that the iron particles are present as thin rafts on the graphite surface. Transmission electron microscopy shows that these rafts are preferentially located along edges and steps on the graphite. Heating to 450 K leads to significant sintering of the iron particles.

38427 Study of charge transfer in back-bonding to carbonyl and nitrosyl groups. Avanzino, S.C.; Bakke, A.A.; Chen, H.W.; Donahue, C.J.; Jolly, W.L.; Lee, T.H.; Ricco, A.J. (Univ. of California, Berkeley). Contract W-7405-ENG-48. *Inorg. Chem.;* **19**: No. 7, 1931-1936(Jul 1980).

The carbon 1s, nitrogen 1s, and oxygen 1s binding energies of a wide variety of transition-metal carbonyl and nitrosyl compounds are subjected to correlative analysis. The carbon 1s and oxygen 1s binding energies of the carbonyls are linearly related to the C-O stretching force constants, and the nitrogen 1s and oxygen 1s binding energies of the nitrosyls are linearly related to the N-O stretching force constants. The data indicate that transfer of electron density to the CO and NO groups is accompanied by weakening of the C-O and N-O bonds. From the relative binding energy shifts it is calculated that, in back-bonding to CO groups, more charge is transferred to the carbon atoms than to the oxygen atoms, and, in back-bonding to NO groups, similar amounts of charge are transferred to the nitrogen and oxygen atoms.

38428 Crystal and molecular structure of (5,10,15,20-tetra-n-propylporphinato)lead(II): a roof porphyrin. Barkigia, K.M. (Brookhaven National lab., Upton, NY); Fajer, J.; Adler, A.D.; Williams, J.B. Contract EY-76-C-02-0016. *Inorg. Chem.;* **19**: No. 7, 2057-2061(Jul 1980).

The structure of (5,10,15,20-tetra-n-propylporphinato)lead(II) has been determined by three-dimensional x-ray diffraction. The compound crystallizes in space group P1, with two molecules per unit cell and lattice constants a = 11.732 (3) A, b = 12.111 (3) A, c = 11.114 (2) A, α = 112.56 (1)°, β = 91.85 (2)°, and γ = 72.85 (2)°. The structure has been refined on F^2 by full-matrix least squares to R/sub F^2/ = 0.057 on the basis of 5570 reflections. Incorporation of the very large Pb(II) ion into the macrocyclic framework principally results in a folding distortion along an axis defined by two opposite methine carbons, rather than by a variation in distances and angles, when compared to free-base tetra-n-propylporphyrin. The molecules pack in pairs with a Pb-Pb distance of 4.256 A, implying no direct metal-metal interaction. A pyrrole ring from a neighboring molecule lies 3.456 A above the Pb(II) ion which suggests a weak π-axial linkage. The possibility that such a roof conformation plays a role in the trigger mechanism for the cooperative binding of oxygen by hemoglobin is considered.

38429 Reduced halides of yttrium with strong metal-metal bonding: yttrium monochloride, monobromide, sesquichloride, and sesquibromide. Mattausch, H.J. (Max-Planck-Institut fuer Festkoerperforschung, Stuttgart, Germany); Hendricks, J.B.; Eger, R.; Corbett, J.D.; Simon, A. Contract W-7405-ENG-82. *Inorg. Chem.;* **19**: No. 7, 2128-2132(Jul 1980).

Reaction of Y with YCl_3 or YBr_3 in sealed tantalum capsules at 1000 to 1150°K leads to the new compounds YCl, YBr, Y_2Cl_3, and Y_2Br_3. All products were characterized by modified Guinier techniques, which led to the following lattice parameters: YCl (hexagonal), a = 374.8 (1), c = 273.8 (9) pm; YBr, a = 380.6 (1), c = 2915.8 (4) pm; Y_2Cl_3 (monoclinic), a = 1514.4 (3) pm, b = 382.5 (1) pm, c = 1007.7 (2) pm, β = 118.24 (2)°; Y_2Br_3, a = 1646.3 (2) pm, b = 389.8 (1) pm, c = 1069.5 (2) pm, β = 120.08 (1)°. YCl and YBr are isotopic with ZrBr and ZrCl, respectively, while Y_2Cl_3 and Y_2Br_3 crystallize in the space group C2/m and are isotypic with Gd_2Cl_3. The structure of Y_2Cl_3 was refined on the basis of single-crystal diffractometer data by least-square techniques (R = 0.048, R/sub w/ = 0.058, Mo Kα). The structure consists of parallel infinite chains of composition Y/sub 4/2/$Y_2Cl_4Cl_2$ formed by condensing M_6X_8-type clusters via trans edges, the shorter metal-metal distances being 326.6 (2) (shared edge), 363.8 (2), and 369.4 (2) pm. A detailed consideration of distances suggests predominantly ionic bonding between Y and Cl with metal-metal bonding within the chains. A discussion is given of the fact that M-M distances in Y_2Cl_3 are 7 to 11 pm less than those in Gd_2Cl_3, in contrast to their nearly identical metallic radii.

38430 Synthesis of a bis(pentamethylcyclopentadienyl) derivative of neodymium. Wayda, A.L.; Evans, W.J. (Univ. of Chicago, IL). *Inorg. Chem.;* **19**: No. 7, 2190-2191(Jul 1980).

It has often been claimed that the syntheses of bis(cyclopentadienyl) chloride complexes of the larger lanthanides fail for steric reasons, and that the use of bulky substituted cyclopentadienyl ligand such as $C_5(CH_3)_5$ should allow the isolation of these important compounds which then could be used in organolanthanide synthesis. By following this idea, crystalline bis(pentamethylcyclopentadienyl) complex of neodymium was successfully isolated and characterized. The reaction of $NdCl_3$ with 2 equiv of LiC_5Me_5 forms a crystalline product which was formulated as $[(C_5Me_5)_2NdCl_2][Li(C_4H_8O)_2]$ based on complete elemental analysis and spectral data.

38431 Formation of 1,1,1-trimethyl-N-sulfinylsilanamine from the direct reaction of SO_2 with hexamethyldisilazane. Davis, J.F.; Spicer, L.D. (Univ. of Utah, Salt Lake City). Contract EY-76-S-02-2190. *Inorg. Chem.;* **19**: No. 7, 2191-2192(Jul 1980).

The direct reaction between sulfur dioxide and the common silylating agent hexamethyldisilazane (HMDS) produced 1,1,1-trimethyl-N-sulfinylsilanamine, $(CH_3)_3Si-N=S=O$. This reaction has not been reported previously and it is believed to be the most direct and efficient synthesis of $(CH_3)_3Si-N=S=O$. The product has fluorescent properties with its ultraviolet absorption bands which suggests that the reaction described may be of considerable interest for trace sulfur dioxide analysis by fluorescent methods. The purified product was characterized by infrared, nuclear magnetic resonance and mass spectroscopy.

38432 (SAND—80-1614) Experimental measurement and theoretical calculation of low vapor pressures at low temperatures. Muendel, C.F. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1980. Translation of Zeitschrift fuer Physikalische Chemie; 85, 435-465, 1913. 46p. NTIS, PC A03/MF A01.

A mercury manometer is described that measures low vapor pressures simply with an accuracy of several thousandths of a millimeter. It was used for low-temperature measurements on substances previously studied by Syndey Young in higher temperature ranges. Temperatures were determined by a mercury thermometer calibrated by the Physical-Technical Federal Institute and a platinum thermometer, which was matched to the temperature scale established by Kamerlingh Onnes by determination of the α value. The temperatures were established at 0.1° for the mercury thermometer, 0.05° for the platinum thermometer. Temperature baths of ether-carbon dioxide mixtures in the range from -10 to -80°, petroleum ether cooled by liquid air to -60 to -130°, liquid air (whose temperature was controlled by flows of hydrogen and oxygen) from -187 to 199°, and liquid hydrogen for -252° were used. Finally, the thermostat tested by Hennig at the Physical-Technical Federal Insti-

tute was used, which proved to be a useful and convenient way to hold a constant temperature in a considerable temperature range. The substances measured by Young, with very few exceptions, were subjected to the same purification procedures, so their boiling points differed only insignificantly. The observations showed that the values calculated with the Nernst vapor pressure equation are sometimes a bit higher, sometimes a bit lower, which was not surprising either, since the pressure constants were found to be 5 to 2000 mm and higher. A new tabulation of the constants, which includes the low pressure region, quickly shows the capabilities of the Nernst vapor pressure equation, since the experimental and theoretical data immediately exhibit good agreement. In addition to these measurements, two solid gases were investigated.

38433 Structure and properties of liquid ammonia. Jorgensen, W.L.; Ibrahim, M. (Purdue Univ., West Lafayette, IN). Contract W-7405-ENG-48. *J. Am. Chem. Soc.;* **102**: No. 10, 3309-3315(7 May 1980).

An intermolecular potential function for the ammonia dimer has been obtained from ab initio molecular orbital calculations with a minimal basis set. Dimerization energies for 250 orientations of $(NH_3)_2$ selected using the iterative energy distributed random geometries method were fit to a 12-6-3-1 potential with standard deviations of 0.2 to 0.3 kcal/mol. The predicted dimerization energy from the potential function is -3.6 kcal/mol. This function and a scaled version yielding a dimerization energy of -4.5 kcal/mol have been used in Monte Carlo simulations of liquid ammonia at its boiling point (-33.35°C). Detailed structural and energetic results have been obtained and are compared with experimental data. The radial distribution functions are not altered significantly by scaling the potential; however, the energy is brought into good agreement with experiment, particularly when three-body effects are considered. The calculated NN radial distribution functions are in better agreement with x-ray results than from earlier molecular dynamics simulations; however, the experimental data are still more structured. Liquid ammonia is predicted to bear little resemblance to the solid. Stereoplots reveal short polymeric chains in the liquid. Although the first peak in g/sub NN/ yields a coordination number of 12 in accord with experiment, most monomers are in only one or two hydrogen bonds and there is 5 to 10% free monomer present. Roughly linear hydrogen bonding predominates.

38434 Resonance Raman/iodine Moessbauer investigation of the starch-iodine structure: aqueous solution and iodine vapor preparations. Teitelbaum, R.C.; Ruby, S.L.; Marks, T.J. (Northwestern Univ., Evanston, IL). *J. Am. Chem. Soc.;* **102**: No. 10, 3322-3328(7 May 1980).

The structure of the blue-black iodine complex of amylose (the linear, helical component of starch), prepared either from iodine and iodide in aqueous solution or from crystalline amylose and iodine vapor, has been studied by resonance Raman and iodine-129 Moessbauer spectroscopy. In both cases it is concluded that the identity of the major chromophore is essentially the same: the pentaiodide (I_5^-) anion. For the material prepared from iodine vapor, the iodide required for I_5^- formation is produced by hydrolysis or alcoholysis of iodine. The other product of this reaction, a hypoiodite, has been assigned in the iodine Moessbauer spectrum.

38435 Are bonds bent? To what extent do bond orbitals follow nuclear motions. Chipman, D.M. (Univ. of Notre Dame, IN); Palke, W.E.; Kirtman, B. *J. Am. Chem. Soc.;* **102**: No. 10, 3377-3383(7 May 1980).

In order to make definitive statements about bent bonds and orbital following accurate ab initio self-consistent valence bond orbitals have been obtained for CH_4, NH_3, H_2O, and H_2S as a function of nuclear geometry. The directions of the orbitals are uniquely determined by the energy minimization criterion. It is found that the bonding orbitals on the central atoms are normally bent a small amount at equilibrium unless constrained to be otherwise by symmetry. More striking is the fact that in almost all cases these orbitals remain nearly stationary as the nuclei undergo bending motions about equilibrium. At the same time there are changes in hybridization which occur in a direction in accord with chemical intuition. Localized molecular orbital calculations were also carried out for comparison purposes. They lead to the same qualitative conclusion that, in general, orbital stasis is a much better approximation than complete orbital following.

38436 Effects of salt concentration and anion on the rate of carrier-facilitated transport of metal cations through bulk liquid membranes containing crown ethers. Lamb, J.D.; Christensen, J.J.; Izatt, S.R.; Bedke, K.; Astin, M.S.; Izatt, R.M. (Brigham Young Univ., Provo, UT). Contract ER-78-S-02-5016. *J. Am. Chem. Soc.;* **102**: No. 10, 3399-3403(7 May 1980).

A study is reported of the variation of cation transport rate through a bulk chloroform liquid membrane containing a neutral macrocyclic carrier with cation concentration in the source salt solution phase and with anion type. The transport rate was found to vary as the square of the cation activity in regions of low cation activity for the four salts studied (KCl, KI, KSCN, and KNO_3) using dibenzo-18-crown-6 (DB18C6) as membrane carrier. However, at high source phase cation activity, transport for some of the salts is less than that expected from this relationship. A mechanism is described to explain these results. The rates of transport of Li^+, Na^+, K^+, and Ba^{2+} salts by DB18C6 or 4-tert-butylbenzo-15-crown-5 were found to be strongly dependent on the anion present. The tranport rates of K^+ salts with DB18C6 ranged over eight orders of magnitude according to anion. Anions with smaller Gibbs free energies of hydration allowed faster cation transport.

38437 Paramagnetic carbon monoxide on magnesium oxide. Morris, R.M.; Kaba, R.A.; Groshens, T.G.; Klabunde, K.J.; Baltisberger, R.J.; Woolsey, N.F.; Stenberg, V.I. (Univ. of North Dakota, Grand Forks). Contract E(49-18)-2211. *J. Am. Chem. Soc.;* **102**: No. 10, 3419-3424(7 May 1980).

Upon exposure of thermally activated MgO to CO, a paramagnetic species is produced at room temperature. A variety of experiments have been carried out in order to elucidate the nature of the CO radical: (1) EPR ^{13}CO experiments with computer simulation indicate that the radical is dimeric; (2) infrared experiments indicate that the radical is anion-like rather than cation-like, and reveal the presence of other CO telomeric species; (3) comparisons of CO/MgO with $C_6H_5NO_2$/MgO reveal that similar sites on MgO are necessary to produce the radical-anion-like species in each case.

38438 Flash photolysis of H_2O vapor in CH_4. H and OH yields and rate constants for CH_3 reactions with H and OH. Sworski, T.J.; Hochanadel, C.J.; Ogren, P.J. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *J. Phys. Chem.;* **84**: No. 2, 129-134(24 Jan 1980).

Methyl radicals, generated by reaction of CH_4 with OH radicals from the flash photolysis of water vapor, decay by reaction with H, OH, and CH_3. The concentration of CH_3 is followed by monitoring the absorption at 216 nm: use of the previously determined values of $(3.1 \pm 0.6) \times 10^{10}$ M^{-1} s^{-1} for $k_3(CH_3 + CH_3)$ and $\epsilon(CH_3) = 9000 \pm 800$ M^{-1} cm^{-1} at this wavelength for a 0.6-nm bandwidth permits calculation of the amount of water dissociated per flash and the values of several rate constants. Measurements were made as a function of CH_4 concentration by using N_2 and H_2 as diluents at atmospheric pressure. When numerical modeling was used to fit the CH_3 data by the method of least squares, it was found that 0.9×10^{-6} M OH and H concentrations are produced under typical operating conditions. The following absolute rate constants (296 K) were obtained: $k_4(H + CH_3 + M \rightarrow CH_4) = (1.2 \pm 0.3) \times 10^{11}$ M^{-1} s^{-1}; $k_5(OH + CH_3 + M \rightarrow$ products$) = (5.6 \pm 1.5) \times 10^{10}$ M^{-1} s^{-1}; $k_2(OH + CH_4 \rightarrow CH_3 + H_2O) = (4.2 \pm 0.4) \times 10^6$ M^{-1} s^{-1}; and $k_6(OH + H_2 \rightarrow H + H_2O) = (5.1 \pm 1.1) \times 10^6$ M^{-1} s^{-1}. The error limits were determined by sensitivity analysis. Information on water dissociation yields under these conditions permits the use of water vapor as a calibrated radical source for the study of other important systems. 29 references, 5 figures, 3 tables.

38439 Convective diffusion with homogeneous and heterogeneous reactions in a tube. Dang, V.D.; Steinberg, M. (Brookhaven National Lab., Upton, NY). Contract EY-76-C-02-0016. *J. Phys. Chem.;* **84**: No. 2, 214-219(24 Jan 1980).

A new complete solution for laminar flow with axial diffusion and first-order homogeneous and wall reactions in a tube is presented. The solution is in terms of an eigenfunction series expansion. Effects of axial diffusion, homogeneous reaction, and wall reaction on the concentration field are discussed. Comparison of the simplified results derived from the present analysis by neglecting axial diffusion and wall reaction with those of previous workers shows good agreement. Conditions are established for the necessity of applying the present results to describe the system accurately. 11 figures.

38440 Study of the crystal structures and nonstoichiometry in the system $Cs_3Sc_2Cl_9$-$CsScCl_3$. Poeppelmeier, K.R.; Corbett, J.D.; McMullen, T.P.; Torgeson, D.R.; Barnes, R.G. (Ames Lab., IA). *Inorg. Chem.;* **19**: No. 1, 129-134(Jan 1980).

The phase $Cs_3Sc_2Cl_9$ has the $Cs_3Tl_2Cl_9$ type structure (R anti 3c, a = 12.707 (2) A, c = 18.117 (4) A) rather than the chromium(III) structure type common to the remainder of the 3d elements. The ^{45}Sc NMR spectra of $ScCl_3$ and of $Cs_3Sc_2Cl_9$, which has been slowly cooled in comparison with that quenched from the melt and annealed, establish that the ternary compound melts somewhat incongruently. Reduction of the scandium(III) phase at elevated temperatures by metal gives $CsScCl_3$ which has the $CsNiCl_3$ structure (hexagonal perovskite, $P6_3/mmc$, a = 7.350 (2) A, c = 6.045 (3) A). The close relationship between the two structures, strings of scandium pairs alternating with vacancies in $Cs_3Sc_2Cl_9$ and fully occupied strings of metal in the reduced limit, allows for an apparent region of nonstoichiometry between the two without x-ray evidence for superstructure ordering of vacancies. Values of R = 0.055 and R/sub w/ = 0.064 were obtained by least-squares refinement of 108 independent reflections from a single crystal with a refined average scandium occupancy of 0.79 (3). Limited refinement

of anti 3m-symmetry diffraction data from the same crystal reveals that the scandium atoms are probably unevenly distributed, namely, as fully occupied pairs with random fractional occupancy of the third site. Precise Guinier powder diffraction data suggest that all scandium sites become crystallographically equivalent above about 87 to 90% average occupancy. The blue $CsScCl_3$ is probably a semiconductor rather than a metallic compound. 4 figures, 3 tables.

38441 Crystal and molecular structures of two square-pyramidal rhodium(I)-sulfur dioxide complexes. Bonding effects in pyramidal-SO_2 complexes. Eller, P.G.; Ryan, R.R. (Los Alamos Scienfific Lab., NM). *Inorg. Chem.;* **19**: No. 1, 142-147(Jan 1980).

The molecular structures of $Rh(ttp)Cl(SO_2)$ and $[Rh(ttp)(CO)(SO_2)](AsF_6)$, where ttp is bis(3-(diphenylphosphino)-propyl)phenylphosphine, have been deduced by single-crystal x-ray diffraction. Both compounds contain square-pyramidal coordination units with apical pyramidal sulfur dioxide ligands. The neutral chloride compound is the most dissociatively and oxidatively stable pyramidal sulfur dioxide-metal complex yet reported and also has the shortest known metal-pyramidal SO_2 distance, 2.326 (5) A. An M-SO_2 distance of 2.433 (6) A is found for the carbonyl complex, which contains labile, reactive sulfur dioxide. A difference of about 90^0 is found in the orientation of the SO_2 group relative to the RhP_3L unit, an effect which is related to the π-bonding characteristics of L. A trans influence of 0.10 A is seen for the Rh-P distance trans to Cl or CO, and the metal is only 0.08 A out the basal plane for the carbonyl but 0.26 A out of the plane for the chloride. These structural and chemical features are related to the donor/acceptor nature of Cl and CO. Crystal data: $Rh(ttp)Cl(SO_2)$, $P2_1/a$, Z = 4, a = 21.327 (8) A, b = 11.244 (3) A, c = 14.617 (6) A, β = 105.05 (2)^0, R = 0.056 for 3515 reflections with $I \geq 2\sigma(I)$; $\{Rh(ttp)(CO)(SO_2)\}\{AsF_6\}$, $P2_1/c$, Z = 4, a = 11.138 (8) A, b = 19.995 (2) A, c = 20.229 (2) A, β = 115.61 (6)^0, R = 0.084 for 2295 reflections with $I \geq 2\sigma(I)$. 2 figures, 6 tables.

38442 Preparation, structure, and spectral characterization of bis[D-β-(2-pyridyl)-α-alaninato]nickel(II), Ni(D-pyala)$_2$. Ebner, S.R.; Helland, B.J.; Jacobson, R.A.; Angelici, R.J. (Ames Lab., IA). *Inorg. Chem.;* **19**: No. 1, 175-180(Jan 1980).

The complex $[Ni(D\text{-}Pyala)_2].2H_2O$ was prepared by reaction of $NiCO_3$ with $D\text{-}^+H_3NCH(CH_2C_5H_4N)CO_2^-$, D-PyalaH, the tridentate analogue of histidine. It was established from three-dimensional x-ray diffraction data that of the three possible isomeric forms the configuration of the complex in the crystalline state is that in which the amino nitrogen atoms are mutually trans. The crystals were monoclinic, of space group $P2_1$, with a = 14.942 (4) A, b = 12.091 (2) A, c = 10.090 (2) A, β = 90.3 (3)^0, V = 1815.58 A^3, d/calcd/ = 1.556 g/cm^3, Z = 4, μ = 11.1 cm^{-1} for Mo, Kα, and R = 0.084. The visible spectrum of the complex suggests that the ligands remain tridentate in aqueous solution, and the circular dichroism spectrum is consistent with the complex having the same configuration as in the solid state. The structural and spectral results are discussed in the context of related complexes. 5 figures, 4 tables.

38443 Alkyl(1,4,8,12-tetraazacyclopentadecane)chromium(III) complexes: kinetics of reactions with mercury(II) and methylmercury(II) ions. Samuels, G.J.; Espenson, J.H. (Ames Lab., IA). *Inorg. Chem.;* **19**: No. 1, 233-235(Jan 1980).

Kinetic data have been obtained on the reactions of R-$Cr([15]aneN_4)(H_2O)^{2+}$ complexes with mercury(II) and methylmercury(II) ions in aqueous perchloric acid. The reactions all follow a second-order rate expression, first order with respect to organochromium concentration and first order in the concentration of the mercury(II) electrophile. The reaction rates vary widely with the structure of R, decreasing sharply with increased steric bulk. The rates are also some 10^2-10^3 higher for Hg^{2+} than for CH_3Hg^+. The reactions are proposed to proceed by the S/sub E/2 mechanism.

38444 Preparation, reactions, and reaction mechanisms of a family of difunctional complexes of bis(benzylchromium) cations. Pohl, M.C.; Espenson, J.H. (Ames Lab., IA). *Inorg. Chem.;* **19**: No. 1, 235-242(Jan 1980).

Six new dimetallic organochromium cations, each containing two benzylchromium-like units per molecule, were prepared from selected dibromides and chromium(II). These tetrapositive complexes (and certain related monochromium analogues) were isolated and purified by ion-exchange chromatography in aqueous solution. The complexes were characterized by their uv-visible absorption spectra and by the stoichiometry and composition of the products obtained from reactions with chloropentaamminecobalt(III) ion, with sodium carbonate, and with mercury(II) chloride. These complexes react with oxidizing agents such as iron(III) ion, copper(II) ion, and halopentaamminecobalt(III) ion in reactions that are first order in the concentration of organochromium ion, but independent of the identity as well as the concentration of oxidizing agent (except for iron(III) ion which shows, for some complexes, a small contribution of an Fe^{2+}-dependent pathway). These data, and comparisons with mononuclear, substituted benzylchromium cations, suggest that the rate-limiting step is unimolecular homolysis of a chromium-carbon bond. The dichromium cations produce only polymer. The monochromium cation $[p\text{-}CrCh_2C_6H_4CH_2OH]^{2+}$ also polymerizes upon oxidation and has k/sub h/ = 1.66 x 10^{-3} s^{-1} at 25^{0}C, consistent with other rates and leading to a Hammett substituent constant for p-CH_2OH of σ/sub p/ = +0.19. The mechanism of homolysis and of the polymerization initiation step are discussed in light of the kinetic data which give no evidence of a biphasic or stepwise loss of the benzylchromium absorption bands used to monitor the reaction rate. 3 tables.

38445 Kinetics and mechanism of adduct formation between iron(III) and bis(dimethylglyoximato)cobalt(III) complexes. Bakac, A.; Espenson, J.H. (Ames Lab., IA). *Inorg. Chem.;* **19**: No. 1, 242-247(Jan 1980).

Iron(III) ion undergoes a reversible association with methyl(aquo)cobaloxime and with diaquocobaloxime in which it replaces the hydrogen-bonded proton in one O-H...O group of the parent cobaloxime. Equilibrium constants for the reaction Fe^{3+} + [XCo/sup III/(dmgH)$_2$H$_2$O]/sup n/ = [XCo(dmg$_2$HFe)H$_2$O]/sup n+2/ + H^+ were evaluated at 25°C, the values for X = CH_3^- being 16.2 +- 0.5 (μ = 0.10 M) and 15.3 +- 0.8 (μ = 1.0 M) and for X = H_2O, 2.55 +- 0.055 (μ = 1.0 M). The rates of both reactions were determined at various concentrations of iron(III) and hydrogen ion, with results consistent with the equilibrium nature of the reactions. The rate laws and rate constants determined are consistent with the mechanism being a process of ligand substitution on iron(III) but are perhaps better explained by a mechanism common to every pathway in which the rate-limiting step is neutralization of the hydrogen-bonded proton of O-H...O by $(H_2O)_5FeOH^{2+}$ with concurrent incorporation of iron into the oxime bridging position. 3 figures.

38446 Chemistry of trifluoromethyl compounds. II. Synthesis and characterization of bis(pyridine)bis(trifluoromethyl)zinc. Liu, E.K.S. (Los Alamos Scientific Lab., NM). *Inorg. Chem.;* **19**: No. 1, 266-268(Jan 1980).

Reported here are the results of the isolation of bis(pyrdine)bis(trifluoromethyl)zinc from the reaction of dimethylzinc and bis(trifluoromethyl)mercury in pyridine. The stability of the resulting compound is due to the pyridine, which, as a result of its electron-withdrawing trifluoromethyl groups evidently satisfies the electronic properties of zinc. IR and NMR spectra were measured, as were thermal stability, solubility, and chemical properties. 1 figure.

38447 Ab initio molecular orbital studies of the structure and potential energy surface of the $LiAlF_4$ complex. Curtiss, L.A. (Argonne National Lab., IL). *Chem. Phys. Lett.;* **68**: No. 1, 225-231(1 Dec 1979).

Ab initio molecular orbital calculations have been carried out on various structures of the $LiAlF_4$ complex using minimal and extended basis sets. A C/sub 2v/ structure with two fluorines in the bridge was found to be more stable than structures with one and three fluorines in the bridge. Migration of the Li^+ in the complex is found to be relatively easy and the AlF_4^- anion is found to be distorted from tetrahedral symmetry.

38448 Crystal structure of $K_{0.54}(Mn,Fe)F_3$ at room temperature. Banks, E. (Polytechnic Inst. of New York, Brooklyn); Nakajima, S.; Williams, G.J.B. *Acta Crystallogr., Sect. B;* **35**: 46-49(1979).

A specimen of flux-grown $K_{0.54}(Mn,Fe)F_3$ was studied at room temperature by single-crystal x-ray diffractometry. The crystal has a structure of the tetragonal tungsten-bronze type with a doubled c axis. The unit-cell parameters are a = 12.765(1), c = 8.002 (1) A, and the space group is $P4_2bc$. Least-squares refinement was carried out with 2395 symmetry-independent reflections collected with an automatic diffractometer (Mo Kα radiation). The final R value (Σ/ F_0^2 - kF/sub c/^{2}//Σ/F_0^2/) is 0.049, with anisotropic thermal parameters. In the structure, K atoms fully occupy pentagonal (CN = 15) sites and partially occupy tetragonal (CN = 12) sites. The transition-metal ions occupy three different kinds of octahedra. The mean M-F distances in each octahedron are: 2.100 A for M(1)-F, 1.939 A for M(2)-F, and 1.995 A for M(3)-F. These distances indicate that the M(1) sites are mainly occupied by bivalent ions, chiefly Mn^{2+}, the M(2) sites by Fe^{3+} and the M(3) sites by Mn^{2+} and Fe^{3+}.

38449 Influence of annealing on the lattice constants of $BaVS_3$. Kelber, J. (Argonne National Lab., IL); Jorgensen, J.D.; Mueller, M.H.; Massenet, O.; Stucky, G. *Acta Crystallogr., Sect. B;* **35**: 2473-2475(1979).

$BaVS_3$, hexagonal, $P6_3/mmc$, Z = 2, D/sub calc/ = 4.30 Mg m^{-3}. Lattice constants for nonferromagnetic and ferromagnetic $BaVS_3$ (as well as BaS content) were determined by profile analysis of time-of-flight neutron diffraction data. Nonferromagnetic sample: a = 6.7160 (4), c = 5.6168 (6) A, BaS impurity < 1.0 at %. Ferromagnetic sample: a = 6.7142 (6), c = 5.6209 (8) A, BaS impurity = 6(2) at %.

38450 Diffraction pattern and models of liquid antimony trichloride. Johnson, E.; Narten, A.H.; Thiessen, W.E.; Triolo, R. (Oak

Ridge National Lab., TN). *Faraday Discuss. Chem. Soc.;* No. 66, 287-295(1978).

Neutron and x-ray diffraction data for liquid $SbCl_3$ at 80°C are presented and discussed. The liquid consists of discrete molecules with an Sb to Cl distance of 2.35 A and a Cl to Sb to Cl angle of 96°. The diffraction data are analyzed to yield structure and correlation functions for intermolecular Sb...Sb, Sb...Cl and C...Cl interactions. These curves yield directly some valuable insight into the nature of the strong orientational correlations present in liquid $SbCl_3$. The data are also used to test site-site interaction models for molecular fluids. The relative role of repulsive and attractive forces for the structure of liquid $SbCl_3$ is discussed.

38451 Structural studies of precursor and partially oxidized conducting conducting complexes. XVI. An x-ray diffraction study of dicesium tetracyanoplatinate hydrogendifluoride $Cs_2[Pt(CN)_4](FHF)_{0.39}$. Schultz, A.J.; Gerrity, D.P.; Williams, J.M. (Argonne National Lab., IL). *Acta Crystallogr., Sect. B;* **34**: 1673-1674(1978).

Body-centered tetragon al, I4/mcm, a = 13.057 (2), c = 5.665 (1) A, Z = 4, D/sub c/ = 3.99 g cm^{-3}. The structure was determined from x-ray diffraction data measured on a Syntex $P2_1$ diffractometer. Based on 407 unique reflections, the final agreement index was $R(F_o^2) = 0.072$. The structure consists of linear stacks, aligned along c, of square-planar $(Pt(CN_4{}^{1\ 61-}$ groups with a Pt-Pt separation of 2.833 (1) A. Neighboring $Pt(CN)_4{}^{1\ 61-}$ groups are rotated 41.7 (5)° with respect to each other. The two independent partially occupied fluorine positions generate a F(1)...F(2) distance of 2.27 (7) A with the $(F\text{-}H\text{-}F)^-$ groups aligned parallel to the c direction.

38452 Structural studies of precursor and partially oxidized conducting complexes. XIV. An x-ray diffraction investigation of one-dimensional potassium tetracyano-platinate bifluoride trihydrate. Brown, R.K.; Johnson, P.L.; Lynch, T.J.; Williams, J.M. (Argonne National Lab., IL). *Acta Crystallogr., Sect. B;* **34**: 1965-1968(1978).

$K_2[Pt(CN)_4](FHF)_{0.3}3H_2O$, KCP(FHF) hereafter, tetragonal, P4mm C/sub 4v/^{1}), a = 9.850 (2), c = 5.846 (1) A, Z = 2, D/sub m/ = 2.61, D/sub x/ = 2.67 g cm^{-3}. A room-temperature single-crystal x-ray diffraction study was performed. The structural solution was obtained by assuming KCP(FHF) to be isostructural with $K_2[Pt(CN)_4]Br_{0.3}3H_2O$, KCP(Br), and by using difference Fourier mapping. The absolute configuration was determined by comparison of solutions utilizing xyz versus xy anti z coordinates and application of Hamilton's R-factor significance test. Refinement using full-matrix least-squares techniques led to $R(F_o^2) = 0.036$ for 876 independent data and to $R(F_o^2) = 0.035$ for the 740 data with $F_o^2 > 1\ \sigma(F_o^2)$. The main structural feature is that the $[Pt(CN)_4]^{1\ 2-}$ groups stack to form Pt-Pt chains, with differing intrachain separations [Pt-Pt = 2.928 (1) and 2.918 (1) A], which are parallel to c, as is the disordered $(F\text{-}H\text{-}F)^-$ anion array.

38453 Comparison of electron and photon beams for determining micro-chemical environment. Isaacson, M.; Utlaut, M. (Univ. of Chicago, IL). *Optik;* **50**: No. 3, 213-234(1978).

From 8. international conference on x-ray optics and microanalysis; Boston, MA, USA (24 Aug 1977).

The effectiveness of performing chemical and electronic spectroscopy is compared for electron and photon beam systems. We derive a figure of merit to compare these systems on the basis of cross-sections, source brightness per unit energy bandwidth and probe size. For obtaining spectroscopic analysis from microscopic areas, we find that electron beam systems can have a higher sensitivity than photon beam systems, but that for obtaining analysis of low concentrations of material averaged over macroscopic areas the reverse may be true. In addition, we compare induced beam damage, multiple scattering and data collection between the two systems. For radiation sensitive materials, electron beams can induce slightly more damage than photon beams of energy less than 10 keV. 59 references, 3 figures.

38454 Bridged ferrocenes. I. Hillman, M.; Gordon, B.; Weiss, A.J.; Guzikowski, A.P. (Brookhaven National Lab., Upton, NY). Contract EY-76-C-02-0016. *J. Organomet. Chem.;* **155**: 77-86(1978).

Previously reported correlations between Moessbauer spectra and the number of bridges in trimethylene bridged ferrocene derivatives have now been observed in the electrode potentials and in the electronic spectra. Crystallographic results reported in the subsequent papers of this series are employed to confirm the previous attribution of these effects to ring-ring tilting, iron-to-ring distance, and to a lesser extent the non-planarity of the rings in some compounds. Rearrangement during the bridging reaction is proposed to explain the failure of the formation of the four-bridged compound. 3 figures, 5 tables.

38455 Bridged ferrocenes. II. Crystal and molecular structure of 1,1'2,2',4,4'-tric(trimethylene)ferrocene. Hillman, M.; Fujita, E. (Brookhaven National Lab., Upton, NY). Contract EY-76-C-02-0016. *J. Organomet. Chem.;* **155**: 87-98(1978).

The crystal and molecular structure of 1,1'2,2'4,4'-tris(trimethylene)ferrocene has been determined by x-ray diffraction. This compound forms monoclinic needles of space group C2/c with sixteen molecules in the unit cell, a 30.899(6), b 9.416(1), c 25.145(1) A and β 127.31(1)°. The structure was solved from three-dimensional Patterson and Fourier syntheses and was refined by least squares. The structure consists of two crystallographically independent molecules showing similar geometries. The two cyclopentadienyl rings are eclipsed and the dihedral angle between the two rings, is 2.4°. The average iron to ring-carbon distance is 1.992 A. The distance between the rings (3.15 A) is significantly shorter than in ferrocene, and the rings appear to be slightly non-planar. 3 figures, 6 tables.

ISOTOPE EXCHANGE AND ISOTOPE SEPARATION

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ORGANIC CHEMISTRY

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 37460, 38420, 38424, 38427, 38428, 38430, 38434, 38435, 38436, 38438, 38441, 38442, 38443, 38444, 38445, 38446, 38454, 38455, 38472, 38485, 38486, 38744

38456 Use of 2,5-dimethyl-2,5-hexane diamine as a curing agent for epoxy resins. Rinde, J.A.; Newey, H.A. (to Dept. of Energy). US Patent Application 005,940. [nd]. 18p.

Primary diamines are prepared for use as a curing agent for epoxy resins. These curing agents can be used to form epoxy resin mixtures useful in filament winding and preimpregnated fiber molding and in formulating film adhesives, powder coatings and molding powders. The epoxy mixtures form for such uses a room temperature non-reacting, intermediate stable state which has a latent cross-linking capability.

38457 (DOE/ER/02837—T1) **Development of empirical potential functions for the study of molecular geometry, and applications to chlorophyll a dimers.** Oie, T. (Kansas Univ., Lawrence (USA). Dept. of Chemistry). 28 Jul 1980. Contract AS02-76ER02837. 127p. NTIS, PC A07/MF A01.

A purpose of the present studies is twofold: (1) development of an empirical potential function (EDF) and (2) application of it to the studies of photoreaction center chlorophyll a dimer. The reliable estimate of geometric structures and energies of large molecules by quantum mechanical methods is not possible at the present time. An alternative method is, therefore, needed for the studies of large molecular systems, and Chapter I is dedicated to the development of this tool, i.e., an empirical potential function, which could suffice this purpose. Because of a large number of variable chemical compositions and functional groups characteristically present in a large molecule, it is important to include a large number of structurally diverse molecules in the development of the EPF. In Chapter II, the EPF is applied to study the geometrical structure of a chlorophyll a (Chl a) dimer, which is believed to exist at the photoreaction center of green plants and is known to play an essential role in photosynthetic energy conversion. Although various models have been proposed for this dimer structure, there is still a great need for information concerning the detailed geometric structure of this dimer. Therefore, in this chapter the structural stabilities of various dimer models are examined by the EPF, and detailed and quantitative information on the structure and stability of these models is provided.

38458 (DOE/ER/04903—2) **Palladium catalyzed coupling reactions: mechanism of reductive elimination. Progress report, October 1, 1979-September 30, 1980.** Stille, J.K. (Colorado State Univ., Fort Collins (USA)). Sep 1980. Contract AS02-78ER04903. 18p. NTIS, PC A02/MF A01.

The 1,1-reductive elimination of ethane from three cis-bis(phosphine)-dimethylpalladium complexes, $L_2Pd(CH_3)_2$ (L = PPh_3, PPh_2CH_3 and $L_2 = Ph_2PCH_2CH_2PPh_2$), and three trans analogs [L = PPh_3, PPh_2CH_3 and L_2 = 2,11-bis(diphenylphosphinomethyl)benzo(c)phenanthrene (TRANSPHOS)] was carried out. The three cis complexes underwent reductive elimination in the presence of coordinating solvents (DMSO, DMF, and THF). The trans complexes which could isomerize to cis (L = PPh_3, PPh_2CH_3) did so in polar solvents and then underwent reductive elimination. TRANSPHOS dimethylpalladium would not undergo reductive elimination of ethane. The eliminations from the cis isomers were intramolecular and displayed first order kinetics. Although TRANSPHOS dimethylpalladium(II) would not undergo a 1,1-reductive elimination of ethane, the addition of CD_3I to a DMSO solution of this complex at 25°C rapidly produced CD_3-CH_3, implicating a transient palladium(IV) intermediate. E- and Z-

bromostyrylbis(diphenylmethylphosphine)palladium(0) react with methyl lithium in THF at ambient temperature to give the E- and Z-propenylbenzenes, respectively. At -78°C, the intermediate E- and Z-styrylmethylbis(diphenylmethylphosphine)palladium(II) complexes (9a,b) can be isolated. On raising the temperature of solutions of 9a,b in THF, E- and Z-propenylbenzenes are produced. The reductive elimination reaction is intramolecular and first order in dialkylpalladium(II) complex.

38459 Mass spectra of fluoroxy and related compounds. Huston, J.L. (Loyola Univ., Chicago, IL); Studier, M.H. *J. Fluorine Chem.;* **13**: 235-249(1979).

Mass spectra have been obtained for CF_3OF, $CF_3(OF)_2$, CF_3OOF, CF_3OOCF_3 and CF_3OOOCF_3. Examples are given of the utility of mass spectrometry for preparation, identification, purification and use of such reactive reagents.

38460 Soft x-ray absorption spectroscopy. Electronic and morphological structure of poly(vinylidene fluoride). Williams, R.S. (Univ. of California, Berkeley); Denley, D.; Shirley, D.A.; Stoehr, J. Contract W-7405-ENG-48. *J. Am. Chem. Soc.;* **102**: No. 18, 5717-5723(27 Aug 1980).

X-ray absorption studies were carried out for the first time on a polymeric thin film in the energy range 250 to 1000 eV, thereby providing access to the K edges of light elements. The carbon and fluorine K edges were studied in poly(vinylidene fluoride). Sharp peaks were observed at both edges, and extended fine structure (EXAFS) was found at higher energies. The carbon K edge showed compound structure, with a chemical shift of 3.9 eV between the Cl(1s) absorption energies in CH_2 and CF_2 groups. This type of shift is similar to, but not identical with, ESCA shifts. Fourier transformation of EXAFS structure above the F K edge yielded a C to F bond distance of 1.38 +- 0.02 A and a second peak at 2.45 +- 0.08 A, which is comprised of contributions from several neighbor shells, providing evidence of structural order. This method is concluded to be useful in studying polymeric electronic structure and molecular conformation.

38461 2,3-Di-n-propyl-1,4-dehydrobenzene. Lockhart, T.P.; Mallon, C.B.; Bergman, R.G. (California Inst. of Technology, Pasadena, CA). Contract W-7405-ENG-48. *J. Am. Chem. Soc.;* **102**: No. 18, 5976-5978(27 Aug 1980).

In this paper, a detailed study of the thermolysis of (Z)-4,5-diethynyl-4-octene (4) is presented. This reaction gives high yields of products formed by rearrangement and intramolecular and intermolecular trapping of the intermediate 1,4-dehydrobenzene 5. The kinetics of the solution pyrolysis of 4 in the presence and absence of trapping agent establish that the 1,4-dehydrobenzene is a discrete intermediate on the pathway leading to products. By following this reaction in the probe of an NMR spectrometer at high temperature, CIDNP in a 1,4-dehydrobenzene reaction was observed for the first time. This observation, along with kinetic and chemical trapping evidence, indicates the subsequent formation of two additional intermediates on the pathway to products. The observation of CIDNP, coupled with the reactivity exhibited by 5 and the other two intermediates, implicate a biradical description of these molecules.

38462 Generation of arenium ions by a self-protonation reaction in an aprotic molten salt medium. Buchanan, A.C. III; Dworkin, A.S.; Smith, G.P. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *J. Am. Chem. Soc.;* **102**: No. 16, 5262-5265(30 Jul 1980).

We have examined the reaction behavior of a group of polycyclic aromatic hydrocarbons in the aprotic liquid $SbCl_3$-10 mol % $AlCl_3$ from 100 to 130°C by ^1H NMR and by quench and separation techniques. For anthracene, pyrene, 9,10-dimethylanthracene, 9,10-diphenylanthracene, and naphthacene, we have observed a novel arene self-protonation reaction for which the proton source is the condensation-dehydrogenation of a portion of the arene combined with arene oxidation by $SbCl_5$. Naphthalene and phenanthrene, however, do not undergo this reaction. Evidence is presented which indicates that the self-protonation reaction proceeds through the oxidation of the arene to its radical cation by $SbCl_5$, and that the function of $AlCl_3$ is to enhance the oxidizing power of the Sb^{3+}/Sb^0 couple.

38463 Ab initio quantum mechanical characterization of the low-lying cation doublet states of uracil. Interpretation of uv and x-ray photoelectron spectra. O'Donnell, T.J. (Univ. of Illinois, Chicago); LeBreton, P.R.; Petke, J.D.; Shipman, L.L. *J. Phys. Chem.;* **84**: No. 15, 1975-1982(24 Jul 1980).

AB initio configuration interaction wave functions have been computed for the ground singlet state and the 10 lowest A′ and A″ cation doublet states of uracil. Both the small molecular fragment basis set and a much larger double zeta basis set have been employed. The experimental ordering of the terminus states in the uracil → uracil$^+$. transitions of the uv photoelectron spectrum is A″, A′, A″, A′, A″ in order from lowest to higher ionization potentials. The molecular fragment basis set gives the experimental ordering with the Koopmans' theorem approximation but gives an incorrect ordering (A′, A″, A′ ~ A″, A′) when configuration interaction is applied. The double zeta basis set, on the other hand, gives an incorrect ordering with the Koopmans' theorem approximation (A″, A″, A′, A′, A″) but gives the experimental ordering after configuration interaction is applied. The best of these calculations utilized the double zeta basis set plus configuration interaction; these results lend support to the previously made assignment of the first five bands of the uv photoelectron spectrum. The results of the double zeta calculation have been used to extend the assignment of the uv photoelectron spectrum to A″, A′, A″, A′, A″, A″, A′, A′. The eight inner-shell molecular orbitals and their orbital energies from the double zeta calculation have been used to assign the experimental x-ray photoelectron spectrum of uracil. The following ordering was computed: O_1 (bonded to C_2), O_2 (bonded to C_4), N_1, N_3, C_2, C_4, C_6, C_5 in order of decreasing ionization potential.

38464 Comparative studies of hydridorhodoxime and its conjugate base, Bis(dimethylglyoximato)rhodate(1-) ion. Ramasami, T.; Espenson, J.H. (Ames Lab., IA). Contract W-7405-ENG-82. *Inorg. Chem.;* **19**: No. 7, 1846-1852(Jul 1980).

Various reactions of the title compounds have been studied, with determinations of products stoichiometry, and kinetics in aqueous methanol. Hydridorhodoxime, HRh(dmgH)$_2$P(C$_6$H$_5$)$_3$,has pK/sub a/ ≈ 9.5. A study of the forward and reverse rates of neutralization reveals three pathways corresponding to reactions of the rhodium (I) anion with H_3O^+, H_2O, and Tham buffer. Hydridorhodoxime is further protonated at the oxime oxygens in acidic solution and decomposes under these conditions to hydrogen and the dimeric Rh(II) derivative [Rh(dmgH)$_2$P(C$_6$H$_5$)$_3$]$_2$. Both title compounds react with organic halides, the base in an S/sub N/2 reaction to form alkyl and aralkyl organorhodoximes and the acid by hydrogen transfer forming the hydrocarbon. The rate constants (k,$M^{-1}s^{-1}$) in the former reactions are 1.66 x 10^4 (benzyl bromide), 1.04 x 10^3 (benzyl chloride), 9.6 x 10 (1-phenylethyl chloride), and 5.2 x 10^{-1} (n-butyl bromide); the respective values for hydridorhodoxime are 9.6 x 10^2, 5.4 x 10, and 1.8 x 10 $M^{-1}s^{-1}$ (with n-butyl bromide not determined, owing to interference from decomposition). Various competition kinetic experiments were also performed to confirm the processes being studied. Reaction mechanisms are presented to account for the results obtained.

38465 Synthesis, spectral characterization, and molecular structure of [N-(2-pyridylmethyl)-L-aspartato](L-phenylalaninato)cobalt(III) trihydrate, [Co(PLASP)(L-Phe)].3H$_2$O. Meiske, L.A.; Jacobson, R.A.; Angelici, R.J. (Ames Lab., IA). *Inorg. Chem.;* **19**: No. 7, 2028-2034(Jul 1980).

The new Co/sup III/N_3O_5 complex [Co(PLASP)(L-Phe)].3H_2O was prepared by the oxidation of Co(II) to Co(III) in the presence of N-2-pyridylmethyl)-L-aspartic acid, $PLASPH_2$, and L-phenylalanine, L-Phe. The crystal and molecular structure of the complex, determined by three-dimensional X-ray analysis, established that of the four possible geometrical isomers, the only isomer isolated was a facial isomer in which the β-COO^- and the pyridine groups of $PLASP^{2-}$ are mutually trans. The compound crystallizes in the orthorhombic space group $P2_12_12_1$, with a = 9.821 (3) A, b = 23.069 (4) A, c = 9.564 (2) A, and Z = 4. The structure was solved by the heavy-atom method and refined by full-matrix least-squares procedures to a final R factor of 0.059. The geometry around the cobalt atom is distorted octahedral, with the $PLASP^{2-}$ ligand being tetradentate and the L-phenylalaninate ligand bidentate. In addition to the crystal structure, the ^1H NMR and visible spectra of [Co(PLASP)(L-Phe)].3H_2O are discussed.

38466 Substrate select'vity and orientation in aromatic substitution by molecular fluorine. Cacace, F. (Univ. of Rome, Italy); Giacomello, P.; Wolf, A.P. *J. Am. Chem. Soc.;* **102**: No. 10, 3511-3515(7 May 1980).

Direct elemental fluorination of representative aromatic substrates, including PhH, $PhCH_3$, PhF, PhCl, PhBr, $PhNO_2$, PhCN, and $PhOCH_3$, has been investigated in inert solvents, e.g., CCl_3F and other fluorocarbons, over the temperature range -154 to 40°C. In order to achieve the necessary control of the extremely reactive electrophile, and to minimize unwanted modifications of the reaction environment, the fluorination has been carried out at extremely low rates and correspondingly low conversions, generally below 0.01%, using as a reagent gaseous mixtures of F_2 highly diluted (<1 mol%) in N_2 or Ar. The partial rate factors, calculated from a consistent set of relative reactivity and orientation data measured at -78°C in CCl_3F, correlate smoothly with the σ^+ constants for all the substituents investigated, giving a rho$^+$ value of -2.45 for aromatic substitution by elemental fluorine with a correlation coefficient of 0.993. These results characterize F_2 as a highly reactive, and correspondently unselective, reagent, and support a polar electrophilic substitution mechanism that is discussed and compared with other plausible fluorination pathways.

38467 Biflora-4,10(19),15-triene: a new diterpene from a termite soldier (isoptera termitidae termitinae). Wiemer, D.F. (Cornell Univ.,

Ithaca, NY); Meinwald, J.; Prestwich, G.D.; Solheim, B.A.; Clardy, J. *J. Org. Chem.;* **45**: No. 1, 191-192(4 Jan 1980).

This communication describes spectrometric, chemical, and x-ray diffraction studies leading to the assignment of the structure to this diterpene. The name assigned is biflora-4,10(19),15-triene on the basis of its skeletal relationship to the violet-red, o-quinonoid antibiotic biflorin, a constituent of the Brazilian medicinal plant Capraria biflora L. The triene was isolated from a hexane extract. The mass spectra and NMR spectra were measured. The compound was esterified with p-bromobenzoyl chloride. The p-bromobenzoate crystallized in the monoclinic crystal system. Lattice parameters were measured. Intensity data were collected on a fully automated four-circle diffractometer. 1666 unique reflections were judged observed after correction for Lorentz, polarization, and background effects. The bromine position was deduced from the Patterson synthesis with complications. Careful selection of atoms finally yielded the correct structure. Full-matrix least-square refinements converged to the current minimum crystallographic residual of 0.090. A computer-generated perspective drawing of the final x-ray model is shown. 1 figure.

38468 Natural abundance ^{13}C NMR spectroscopy of double-stranded DNA. Rill, R.L.; Hilliard, P.R. Jr.; Bailey, J.T.; Levey, G.C. (Florida State Univ., Tallahassee). *J. Am. Chem. Soc.;* **102**: No. 1, 418-420(2 Jan 1980).

Two superconducting solenoid-based spectrometers were used to acquire ^{13}C NMR spectra at 67.9 and 37.7 MHz. High-field spectra were taken on the SEMINOLE spectrometer equipped with a broad-band side spinner design probe. A sample spectrum of native DNA is shown. A table summarizes data from five spectra, three of native DNA, one of heat denatured DNA, and one of native DNA containing intercalated ethidium bromide. The data appear to indicate that natural abundance ^{13}C spectroscopy of ~ 140-NP native DNA is practical. Isolation of smaller double-stranded DNA molecules by the same methods combined with improvements in probe and instrument design, should enhance spectral quality and permit careful examination of structural details of DNA alone and in combination with specific chemical agents. 1 figure, 1 table.

38469 Ring conformations of proline. Solution studies based on lanthanide nuclear magnetic resonance shifts and molecular mechanics. DeTar, D.F.; Luthra, N.P. (Florida State Univ., Tallahassee). Contract (40-1)-2690. *J. Org. Chem.;* **44**: No. 19, 3299-3305(14 Sep 1979).

Previous studies of ring conformational equilibria of proline based on molecular mechanics computations show the presence of two shallow energy minima: A is a half chair with C/sup γ/ up and C/sup β/ down with respect to the average plane of the ring and with the carboxyl group up; B is an envelope with C/sup γ/ down. Evaluation of available x-ray data showed that in the solid state the reported conformations cluster about one or the other of these conformations of the theoretical minimum energy. The present study concerns the conformational states of the proline ring in solution in $CDCl_3$ and is based on lanthanide NMR shift studies. The shift reagents $Yb(fod)_3$ and $Eu(fod)_3$ gave 25 usable shift values with Ac-L-Pro-OCH_3 and 29 with Bz-Pro-OCH_3. The shift results are consistent with a conformational mixture of roughly 60 parts of A and 40 of B. Assumption of a planar average ring conformation gives a poorer account of the data and the data are inconsistent with a ring having a single intermediate conformation derived from either A or B. The lanthanide shift data were processed by a molecular mechanics program modified so as to permit simultaneous adjustment of lanthanide parameters, substrate geometry, and conformer mole fractions. Minor adjustment of substrate geometry gave dramatic improvement in the agreement factor between observed and calculated induced shift values, and the observed values have been reproduced to within experimental error. We provide a probable explanation of the variable and unrealistically long lanthanide-oxygen distances commonly reported in LIS studies. This is a consequence of representing a physical system made up of many complexes in rapid equilibrium by one single mathematically averaged complex. 2 figures, 3 tables.

38470 Crystal structure of 2,6-di-tert-butyl-5,6-epoxy-2,4-dihydroxy-4-methyl-1,3-cyclohexanedione, an oxidation product of 2,6-di-tert-4-methylphenol (BHT). Rafferty, P.; Benjamin, B.M.; Raaen, V.F.; Thiessen, W.E.; Johnson, C.K. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Acta Crystallogr., Sect. B;* **35**: 2067-2071(1979).

2,6-Di-tert-butyl-5,6-epoxy-2,4-dihydroxy-4-methyl-1,3-cyclohexanedione, $C_{15}H_{24}O_5$ was isolated from the product mixture obtained by carefully controlled permanganate oxidation of 2,6-di-tert-butyl-4-methyl-phenol. Crystals are triclinic (space group P1) with cell parameters (T = 297 K) a = 8.901 (13), b = 12.388 (8), c = 7.302 (6) A, α = 100.79 (5), β = 94.02 (10), γ = 99.07 (10)°, Z = 2, and V = 776.78 A^3 based on λ(Mo Kα) = 0.71069 A. The structure was solved from x-ray diffraction data and refined by a least-squares procedure to an agreement index of 0.061 on F^2 for 3612 unique reflections. The cyclohexane ring is stabilized in the boat conformation by internal hydrogen bonds. The two tert-butyl substituents undergo internal torsional oscillation with amplitudes of 6.0 and 6.8° r.m.s. The epoxy group has a C-C distance of 1.472 (3) A and C-O distances of 1.457 (2) and 1.433 (3) A (1.479, and 1.440 A, respectively, when corrected for thermal motion) reflecting its conjugation with a neighboring carbonyl group.

ISOTOPE EFFECTS

REFER ALSO TO CITATION(S) 38494

ISOTOPE EXCHANGE AND ISOTOPE SEPARATION

38471 Laser-stimulated chemical reaction $I_2 + C_2H_2$. Kushawaha, V.S. (Ames Lab., IA). Contract W-7405-ENB-82. *J. Am. Chem. Soc.;* **102**: No. 1, 256-258(2 Jan 1980).

The laser-initiated chemical reaction of $I_2 + C_2H_2$ has been studied by exciting the B-X system of the I_2 molecule at 4880, 5145, and 6040 A, using the output from an Ar^+ laser and a CW dye laser pumped by an Ar^+ laser. At 5145 and 4880 A, the reaction products were mostly $C_2H_2I_2$ and a trace amount of $C_2H_2I_4$, which was greater at 4880 A than at 5145 A and satisfactorily correlated with the excited iodine atoms produced at these wavelengths; $C_2H_2I_2$ was the only product at 6040 A. A mechanism for the reaction of the laser-excited I_2 with the C_2H_2 has been proposed and, on the basis of thermal experiments, has been indicated to be nonthermal. 17 references, 2 figures.

38472 Disproportionation of trimethylsilyl radicals to a sila olefin in the liquid phase. Cornett, B.J.; Choo, K.Y.; Gaspar, P.P. (Washington Univ., St. Louis, MO). *J. Am. Chem. Soc.;* **102**: No. 1, 377-378(2 Jan 1980).

In the presence of excess tert-butyl alcohol, the product ratio of $Me_3COSiMe_3/Me_3SiSiMe_3$ = 0.19 +- 0.05 remained constant with photolytic irradiation time. That 2-methyl-2-silapropene was being trapped was demonstrated by use of Me_3COD either generated in situ from Me_3SiD or added in excess. $Me_3COD + CH_2 = SiMe_2 \rightarrow Me_3COSiMe_2CH_2D$. Formation of this monodeuterated tert-butoxytrimethylsilane was established by ^1H NMR and mass spectroscopy. It is believed that the disproportionation of trimethylsilyl radicals in solution is established by these trapping experiments with deuterated tert-butyl alcohol. 13 references.

ELECTROCHEMISTRY

REFER ALSO TO CITATION(S) 37852, 37856, 38900

38473 (ORNL—5665, pp 170-180) **Electrochemistry.** Jul 1980. In Chemistry Division annual progress report, February 29, 1980.

The following six topics were studied: role of halide ions in localized corrosion of Ti, corrosion of carbon steel in concentrated chloride solutions, Maclaurim series analysis of polarization curves, electrochemical model for high-temperature anodic film growth, effects of redox couples on kinetics of Ti dissolution, and simplified model for porous electrode reactors. 8 figures. (DLC)

38474 (SAND—80-0960C) **Current and potential distributions in corrosion systems.** Smyrl, W.H. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 22p. (CONF-800802—20). NTIS, PC A02/MF A01.

From 89. annual meeting of the American Institute of Chemical Engineers; Portland, OR, USA (17 Aug 1980).

Current and potential distribution calculations in corrosion are reviewed. The mathematical methods used, and the specific results for galvanic corrosion, cathodic protection, and localized corrosion are described.

38475 Energy by reverse electrodialysis. Lacey, R.E. (South Res Inst, Birmingham, Ala). *Ocean Eng.;* 7: No. 1, 1-47(1980).

In principle, energy can be derived from the difference between the chemical potentials of concentrated and dilute salt solutions. Among the potential sources are the brines of oil and natural gas fields, the brines from flooding of salt domes, the brines of salt lakes, and even the waters of oceans and bays, provided less salty water is also nearby. The potential of these sources of energy has long been recognized, but the economic conversion of the energy to a useful form has yet to be realized. Of the many approaches to the recovery of this energy, one which appears promising, but inadequately explored, is "reverse electrodialysis", which is the reverse of the well-known process for desalination. When a concentrated salt solution flows through alternating cells and fresh water flows through the others, a voltage is generated across each ion-exchange membrane. The back-e.m.f. represented by the electrode reactions is small compared to the sum of the transmembrane voltages, which are additive. Useful power may accordingly be obtained from leads to the electrodes. The paper discusses the process, including sources

of brines, reverse electrodialysis (RED) research, analysis of RED units, power output, and power unit costs. Refs.

PHOTOCHEMISTRY

REFER ALSO TO CITATION(S) 37852, 37853, 37854, 37855, 37856, 38412, 38438, 38471, 38490, 38699, 38753, 38764, 38766

38476 (COO—4695-4) **Study of combustion and flame processes initiated by IR laser-induced absorption. Annual progress report, January 1, 1980-December 31, 1980.** Guillory, W.A. (Utah Univ., Salt Lake City (USA)). 1 Aug 1980. Contract AS02-78ER04695. 15p. NTIS, PC A02/MF A01.

In this study, simulated flame and combustion processes were initiated by multiple-photon absorption from high power infrared (IR) laser sources. Subsequent examination of the system was performed by dye laser induced fluorescence (LIF), multiphoton spectroscopy, and visible and infrared emission. To understand combustion and flame reaction, a knowledge of the kinetic role of free radicals such as C_3, CH, C_2, and OH, is critical. For this reason the reaction dynamics of the C_3 radical in the presence of O_2, NO and various hydrocarbons was investigated. The production of C_3 radicals, vibrational relaxation and chemical kinetics following IR photolysis of allene are discussed.

38477 Heterogeneous electron transfer at designed semiconductor/liquid interfaces. Rate of reduction of surface-confined ferricenium centers by solution reagents. Lewis, N.S.; Bocarsly, A.B.; Wrighton, M.S. (Massachusetts Inst. of Tech., Cambridge). *J. Phys. Chem.;* **84**: No. 16, 2033-2043(7 Aug 1980).

Reduction of surface-confined ferricenium by solution reductants iodide, diindenyliron, (eta^5-C_9H_5)$_4$$Fe_4(CO)_4$, 1,1'-dimethylferrocene, ferrocene, and phenylferrocene has been studied in EtOH-0.1 M [n-Bu_4N]ClO_4 and also in H_2O-$NaClO_4$ for iodide. The surface-confined ferricenium can be generated on n-type Si by illumination of the electrode at some potential more positive than ~ -0.2 V vs. SCE. Linear sweep voltammetry was used to directly measure the time dependence of the surface ferricenium concentration in the dark and in the presence of the various reducing agents. The rate constant for the reaction with iodide was measured in both solvents, and the value in EtOH is somewhat lower than would be estimated from homogeneous solution reaction of ferricenium with iodide under the same conditions. Values of reaction rate constants for reaction with all other reductants indicate that the reduction rate is mass transport, not charge transfer, limited under the conditions employed. The relative ordering of the fast reductants has been determined to be diindenyliron > (eta^5-C_9H_5)$_4$$Fe_4(CO)_4$ ~ 1,1'-dimethylferrocene > ferrocene ~ phenylferrocene. Most of the derivatized surfaces have been prepared from (1,1'-ferrocenediyl)dichlorosilane, but preliminary results with polyvinylferrocene modified and (1,1'-ferrocenediyl)dimethylsilane derivatized surfaces are similar. Very high coverage surfaces from (1,1'-ferrocenediyl)dichlorosilane show some evidence for selective reduction of the more accessible ferricenium centers when a fast reductant is used. Steady-state photoanodic current at a given concentration of reductant generally accords well with the measured k/sub et/ values, and for the iodide experiments the steady-state photocurrent is directly proportional to surface coverage of electroactive ferrocene.

38478 Role of dimensionality and spatial extent in influencing intramicellar kinetic processes. Hatlee, M.D. (Univ. of Notre Dame, IN); Kozak, J.J.; Rothenberger, G.; Infelta, P.P.; Graetzel, M. *J. Phys. Chem.;* **84**: No. 12, 1508-1519(12 Jun 1980).

A combined experimental and theoretical study was undertaken to explore the role of dimensionality and spatial extent in influencing intramicellar kinetic reactions. Three qualitatively different types of energy-transfer reactions were studied: (1) the diffusion of a confined photoexcited species to a reactive surface; (2) the energy transfer between two completely compartmentalized reactants; and (3) the chemical reaction between species restricted in their diffusional motion to the surface of the micelle. The theoretical framework within which the dynamics of these three processes were studied was the continuum theory of reaction-diffusion kinetics. It was found that the theory developed correctly predicts the emergence of pseudo-first-order behavior, with attendent (effective) rate constants in qualitative (and near quantitative) accord with the experimental results.

38479 147-nm photolysis of disilane. Perkins, G.G.A.; Lampe, F.W. (Pennsylvania State Univ., University Park). Contract EY-76-S-02-3416. *J. Am. Chem. Soc.;* **102**: No. 11, 3764-3769(21 May 1980).

The photodecomposition of Si_2H_6 at 147 nm results in the formation of H_2, SiH_4, Si_3H_8, Si_4H_{10}, Si_5H_{12}, and a solid film of amorphous silicon hydride (a-Si:H). Three primary processes are proposed to account for the results, namely, (a) $Si_2H_6 + h\nu \rightarrow SiH_2 + SiH_3 + H$ (phi/sub a/ = 0.61); (b) $Si_2H_6 + h\nu \rightarrow SiH_3SiH + 2H$ (phi/sub b/ = 0.18); (c) $Si_2H_6 + h\nu \rightarrow Si_2H_5 + H$ (phi/sub c/ = 0.21). The overall quantum yields depend on the pressure but at 1 Torr partial pressure of Si_2H_6 are PHI(-Si_2H_6) = 4.3 +- 0.2, PHI(SiH_4) = 1.2 +- 0.4, PHI(Si_3H_8) = 0.91 +- 0.08, PHI(Si_4H_{10}) = 0.62 +- 0.03, PHI(Si,wall) = 2.2. Quantum yields for H_2 formation were not measured. A mechanism is proposed which is shown to be in accord with the experimental facts.

38480 Selective enhancement of bimolecular reaction rates by over three orders of magnitude using low intensity CW infrared laser radiation. Bomse, D.S.; Beauchamp, J.L. (California Inst. of Tech., Pasadena). *J. Am. Chem. Soc.;* **102**: No. 11, 3967-3969(21 May 1980).

Irradiation of the complex system represented by the equilibrium $(CH_3OH)H^+(OH_2)$ + CH_3OH reversible $(CH_3OH)_2H^+$ + H_2O enhances the reverse reaction by more than three orders of magnitude. Ion cyclotron resonance (ICR) spectroscopy indicated that forward reaction is unaffected by laser irradiation. Additionally, the proton-bound methanol dimer was found to undergo multiphoton excitation followed by unimolecular decomposition represented by the reaction: $(CH_3OH)_2H^+ \rightarrow (CH_3)_2OH^+ + H_2O$. (BLM)

38481 Carbanion photochemistry. 2. Kinetic control of product formation in reactions of radicals with carbanions. Tolbert, L.M. (Univ. of Kentucky, Lexington). *J. Am. Chem. Soc.;* **102**: No. 10, 3531-3534(7 May 1980).

The interaction of resonance-stabilized carbanions with methyl radicals produced by the irradiation of the carbanions in dimethyl sulfoxide is governed by the pK/sub a/ of the carbanion conjugate acid to a greater extent than by the stability of the resulting radical anion. This kinetic effect is explained using energetic considerations based on the Hammond postulate and is further rationalized by a molecular orbital correlation diagram.

38482 Photooxygenation of aziridines and some potential azomethine ylides. Bhat, V. (Indian Inst. of Technology, Kanpur, India); George, M.V. *J. Org. Chem.;* **44**: No. 19, 3288-3292(14 Sep 1979).

Sensitized photooxygenations of a few bicyclic aziridines and some potential azomethine ylides have been investigated. The photooxygenation of 1-cyclohexyl-6-(cyclohexylimino)-1a-phenylindano[1,2-b]aziridine gave a 51% yield of 2-cyclohexyl-3-hydroxy-3-phenylphthalimidine. The photoxygenation of endo-2,4,6-triphenyl-1,3-diazabicyclo[3.1.0]hex-3-ene, on the other hand, gave a mixture of products consisting of benzaldehyde (5%), benzoic acid (5, 16%), and benzamide (19, 7%). Other substrates that we have examined include 2,3-dihydro-5,6-diphenylpyrazine (22), cis-2,4,5-triphenylimidazoline (33a), and 4-benzoyl-3-cyclohexyl-5-(cis-1,2-diphenylvinyl-2-phenyloxazoline (42). The photooxygenation of 22, for example, gave a 22% yield of 1,3-dibenzoylurea, whereas 33a, under analogous conditions, gave a mixture of products consisting of 2,5,5-triphenylimidazolin-4-one (7%), dibenzamide (8%), and 19 (21%). The photooxygenation of 42 gave a mixture of products consisting of 5 (51%) and N-cyclohexylbenzamide (19%), whereas the direct photolysis of 42 under nitrogen atmosphere gave a 65% yield of 3,5,6-triphenyl-2H-pyran-2-one. Reasonable mechaisms have been suggested for the formation of the different products in these reactions.

38483 Solution chemistry of surfactants. Volume 2. Thomas, J.K.; Almgren, M. (Univ. of Notre Dame, IN). pp 559-573 of Promotion of photochemical reactions by micellar systems. Mittal, K.L. (ed.). New York, NY; Plenum Publishing Corporation (1979).

The effect of micelles on photochemically induced reactions is discussed in terms of conventional theories of micellar catalysis of reactions. In particular, photoinduced electron transfer and photoionization are discussed where micelles both increase the yield of these processes and also in the case of photo-ionization lower the ionization threshold. The influence of reactant solubilization site on the processes is also discussed.

38484 Photooxygenation of aziridines and some potential azomethine ylides. Bhat, V. (Indian Inst. of Tech., Kanpur); George, M.V. *J. Org. Chem.;* **44**: No. 19, 3288-3292(1979).

Sensitized photooxygenations of a few bicyclic aziridines and some potential azomethine ylides have been investigated. The photooxygenation of 1-cyclohexyl-6-(cyclohexylimino)-1a-phenylindano[1,2-b]aziridine (7) gave a 51% yield of 2-cyclohexyl-3-hydroxy-3-phenylphthalimidine (12). The photooxygenation of endo-2,4,6-triphenyl-1,3-diazabicyclo[3.1.0]hex-3-ene (13), on the other hand, gave a mixture of products consisting of benzaldehyde (16,5%), benzoic acid (5,16%), and benzamide (19,7%). Other substrates that we have examined include 2,3-dihydro-5,6-diphenylpyrazine (22), cis-2,4,5-triphenylimidazoline (33a), and 4-benzoyl-3-cyclohexyl-5-(cis-1,2-diphenylvinyl)-2-phenyloxazoline (42). The photooxygenation of 22, for example, gave a 22% yield of 1.3-dibenzoylurea (32), whereas 33a, under analogous conditions, gave a mixture of products consisting of 2,5,5-triphenylimidazolin-4-one (40,7%), dibenzamide (36,8%), and benzamide (19,21%). The photooxygenation of 42 gave a mixture of products consisting of benzoic acid (5,52%) and N-cyclohexylbenzamide (45,19%), whereas the direct photolysis of 42

under nitrogen atmosphere gave a 65% yield of 3,5,6-triphenyl-2H-pyran-2-one (50). Reasonable mechanisms have been suggested for the formation of the different products in these reactions.

RADIATION CHEMISTRY

38485 (BNL—51271) **Polysulfones for conservation in the ethylene polymer industry. Progress report No. 8, April-June 1980.** Steinberg, M.; Johnson, R.; Elling, D.; Bernstein, P.; Varker, A.E. (Brookhaven National Lab., Upton, NY (USA)). Aug 1980. Contract AC02-76CH00016. 17p. NTIS, PC A02/MF A01.

Ethylene SO_2 polysulfone copolymers were prepared by both cobalt-60 gamma irradiation and chemical catalysis as a means of incorporating a polluting waste material such as SO_2 into useful ethylene polymers and also for the purpose of conserving ethylene feedstock. In addition, ethylene-SO_2 copolymer was prepared with monomeric acrylates and vinyl acetate to produce a modified material. Discs of modified and unmodified ethylene-SO_2 copolymer were pressure molded.

38486 (DOE/ER/01763—T1) **Pulse radiolysis of fast reactions in molecular systems. Progress report, November 1979-September 1980.** Dorfman, L.M. (Ohio State Univ., Columbus (USA)). 1980. Contract AS02-76ER01763. 12p. NTIS, PC A02/MF A01.

The rates of elementary chemical reactions in irradiated solutions are being studied by observation of reactive intermediates using the pulse radiolysis technique. Optical absorption spectra of these transient species, which determine the course of the chemistry, are being obtained. The types of reactive species currently of interest are organic molecule ions (both cations and anions) and radical ions, and transition metal carbonyl radicals in solution. Since reaction is initiated by a pulse of high energy electrons, our investigations inherently relate to radiation chemical systems. The information obtained is, however, also of interest in various areas of organic reaction kinetics in which ionic species are known to play a central role. The rectivity of the transition metal carbonyl radicals is of interest in the area of homogeneous catalysis. Current activities involve: spectra and reactivities of transition metal carbonyl radicals of the type $M(CO)_8$; reactivity of organic ionic species (including carbocations and carbanions) in irradiated solutions.

38487 **Yield for the scavenging of OH radicals in the radiolysis of N_2O-saturated aqueous solutions.** Schuler, R.H.; Patterson, L.K.; Janata, E. (Univ. of Notre Dame, IN). *J. Phys. Chem.;* **84**: No. 16, 2088-2089(7 Aug 1980).

A study was undertaken to calibrate the thiocyanate dosimeter most commonly used for determination of OH concentration in pulse radiolysis experiments. The dosimeter which involves 10^{-2} M SCN^- in N_2O-saturated solutions was calibrated against the Fricke system. The calibration led to a value of 46,400 +- 600 (molecules/100 eV) M^{-1} cm^{-1} for the product of yield and extinction coefficient of $(SCN)_2^-$ at 10^{-2} M SCN^-. This yield is 10-15% greater than most previously quoted values. It is emphasized that yields of OH scavenging processes are significantly dependent on solute concentration and that reports of radiolysis dosimetry should specify the reference system being used in order that results may be correlated. (BLM)

38488 **γ-radiation-oxidation of polycyclic aromatic hydrocarbons: involvement of singlet oxygen/sup 1a,b/.** Clough, R.L. (Sandia National Labs., Albuquerque, NM). Contract DE-AC04-76-DP00789. *J. Am. Chem. Soc.;* **102**: No. 16, 5242-5245(30 Jul 1980).

Oxidation of organic compounds in the presence of high-energy radiation is generally understood in terms of organic free-radical mechanisms. We investigated the chemistry of certain polycyclic aromatic hydrocarbons in oxygenated solutions submitted to γ-radiation from a cobalt-60 source in an effort to identify and study other pathways in radiation oxidation. Products obtained could be explained either through singlet oxygen ($^1O_2$) production, through superoxide (O_2^-.) production, or through a cation radical mediated reaction with O_2. Quenching experiments clearly established singlet oxygen as the intermediate involved. The oxidation products varied markedly depending on the starting compound. This resulted because the primary endoperoxide adducts were subject to radiation-induced decomposition both by retrograde O_2 expulsion and by breakdown to quinones. It was also found that certain common $^1O_2$ quenchers were ineffective in the radiation environment because of decomposition.

38489 **Electrophilic reaction of the OH radical with phenol: determination of the distribution of isomeric dihydroxycyclohexadienyl radicals.** Raghavan, N.V.; Steenken, S. (Univ. of Notre Dame, IN). *J. Am. Chem. Soc.;* **102**: No. 10, 3495-3499(7 May 1980).

Using pulse radiolysis with optical detection and high-pressure liquid chromatography techniques it is shown that the isomeric dihydroxycyclohexadienyl radicals formed in aqueous solution by reaction of OH with phenol react with quinones by electron transfer to yield semiquinones and dihydroxybenzenes. The rate constants for these electron-transfer reactions depend on the redox potential of the quinone and on the isomer structure of the dihydroxycyclohexadienyl radical; i.e., the rate constants are large (10^9-$10^9$$M^{-1}s^{-1}$)in the case of the ortho and para isomers and small ($\leqq$ $10^7$$M^{-1}s^{-1}$)in the case of the meta and ipso isomers. The isomeric dihydroxycyclohexadienyl radicals differ also with respect to their rates of H^+-catalyzed dehydration to yield phenoxyl radical. It is thus possible to distinguish kinetically between the different dihydroxycyclohexadienyl radicals. On this basis and from the product analysis data the fractions of OH attack at the ipso, ortho, meta, and para position of phenol are 0.08, 0.48, 0.08, and 0.36, respectively. These data show the strong preference of the electrophilic OH radical for attack at the ring positions activated by the phenolic OH group.

38490 **Visual pigments. 11. Spectroscopy and photophysics of retinoic acids and all-trans-methyl retinoate.** Takemura, T. (Univ. of Houston, TX); Chihara, K.; Becker, R.S.; Das, P.K.; Hug, G.L. *J. Am. Chem. Soc.;* **102**: No. 8, 2604-2609(9 Apr 1980).

The photophysics of hydrogen-bonded complexes of retinoic acid and its 9-cis and 13-cis isomers and the photophysics of the dimers of these isomers of retinoic acid were studied. The investigation indicated that complexes of retinoic acid and molecules that form hydrogen bonds with the carbonyl oxygen of retinoic acid (type I complexes) have both higher radiative and nonradiative rate constants than do hydrogen-bonded complexes of retinoic acid and molecules that form hydrogen bonds only with the hydroxyl oxygen of retinoic acid (type II complexes). For all-trans-retinoic acid in 3-methylpentane at 77 K, the type I complexes have radiative rate constants approximately equal to or greater than 2 x 10^8 s^{-1} and nonradiative rate constants greater than 3 x 10^8 s^{-1}. Both the radiative and nonradiative rate constants of the type II complexes of all-trans-retinoic acid at 77 K in 3-methylpentane are less than 1 x 10^8 s^{-1}. The dimer of retinoic acid (K(association) = 1 x 10^4 M^{-1} at room temperature for the all-trans isomer) behaves like a type I complex, and its excited-state properties are better understood in terms of hydrogen bonding than in terms of an exciton model. The photophysical properties and triplet-triplet absorption spectrum of methyl retinoate were measured. The study concluded with an examination of some of the implications of this work for the role of hydrogen bonding in the dimers and monomers of retinal and retinol.

38491 **Spectra, yields, and photolability of cations, carbanions, radicals, and scavenger anions in γ-irradiated alkane glasses.** Bhattacharya, D.; Willard, J.E. (Univ. of Wisconsin, Madison). Contract EY-76-S-02-1715. *J. Phys. Chem.;* **84**: No. 2, 146-155(24 Jan 1980).

The overlapping spectra of the cations, carbanions, and radicals responsible for the broad observed spectrum from 200 to 800 nm in γ-irradiated alkane glasses at cryogenic temperatures have been resolved in 3-methylpentane (3MP) and 2-methylpentane (2MP). Extinction coefficients have been assigned to these species and to the scavenger anions SF_6^-, Cl_2^-, and Br_2^- formed in the glasses. The λ/ sub max/ values in 3MP, and the extinction coefficients are as follows: $3MP^+$, 490 nm, 153 M^{-1} cm^{-1}; R., 218 nm, 1675 M^{-1} cm^{-1}; $R:^-$, 240 nm, 6300 M^{-1} cm^{-1}; SF_6^-, ϵ^{350} = 573 M^{-1} cm^{-1}; Cl_2^-, 350 nm, 3257 M^{-1} cm^{-1}; Br_2^-, 365 nm, 4238 M^{-1} cm^{-1}. In 3MP which has received a 2.8 x 10^{19} eV g^{-1} γ dose at 68 K, G($R:^-$) is ~ 0.3. Nearly all of the e^- produced by photoejection from the $R:^-$ are trapped by the matrix rather than reacting with cations. When the e/ sub t/$^-$ are mobilized by IR light, ~ 12% react with R. to form $R:^-$ and 88% neutralize cations. The ratio of radicals formed by the neutralization process to electrons neutralized is 0.27. The trapped cations can be removed by exposure to light in their absorption band. In 3MP and 2MP containing both the electron scavenger SF_6 and the positive charge scavenger 2MP-1, G(cations) = G(anions) = 5.4 +- 0.5. 8 figures, 3 tables.

38492 **Radiolytic-chemical method for production of gases.** Lewis, J.G.; Martin, A.J.; Meinke, W.W.; Ricker, C.W.; Teitel, R.J. (to Texas Gas Transmission Corp.). US Patent 4,175,016. 20 Nov 1979. Filed date 30 Mar 1976. 4p.

This invention describes an improved method for radiolytic-chemical gas production. Oxides of nitrogen are used to prevent combination of the combustible fuels with oxygen during radiolysis. In addition, they are useful in separating surplus oxygen from combustible fuel residual gases. The multi-step method is arranged so that all chemicals, except for feed and product materials, are completely recycled.

38493 **Hydrogen concentration profiles in quartz determined by a nuclear reaction technique.** Clark, G.J. (Oak Ridge National Lab., TN); White, C.W.; Allred, D.D.; Appleton, B.R.; Tsong, I.S.T. *Phys. Chem. Miner.;* **3**: 199-211(1978).

The nuclear reaction $^{19}F(^1H, \alpha\ \gamma)^{16}O$ has been used to determine the hydrogen concentration in natural and in synthetic quartz samples. The depth-profile of the hydrogen concentration in these samples has been determined in detail for the smoky and X_0

quartzes. These profiles exhibit a region of high hydrogen concentration in the near surface region (down to a depth of ~ 2000 A), with a lower concentration in the bulk of the sample. The results provide a plausible explanation for the substantial disagreement between previous hydrogen analysis in these quartzes by other techniques. Evidence for hydrogen mobility in crystalline quartz under ion beam bombardment is presented and discussed. 8 figures, 1 table.

RADIOCHEMISTRY AND NUCLEAR CHEMISTRY

HOT-ATOM CHEMISTRY

38494 Thermal chlorine-38 reactions with propyne. Lee, F.S.C.; Rowland, F.S. (Univ. of California, Irvine). Contract DE-AT-03-76ER 70126. *J. Phys. Chem.;* **84**: No. 15, 1876-1881(24 Jul 1980).

Thermal ^{38}Cl atoms are formed by moderation in collision with $CClF_3$ of the extra kinetic energy given to the recoil atoms from the $^{37}Cl(n,\gamma)^{38}Cl$ nuclear reaction. These thermal ^{38}Cl atoms react with propyne at 25°C almost entirely by addition, with less than 5% reacting by H-atom abstraction. Terminal addition is favored over central addition by a factor of 8 +- 1 to 1. After stabilization by collision, the terminal $CH_3C{=}{=}CH^{38}Cl$ radicals react stereoselectively with HI to form almost exclusively cis-$CH_3CH{=}{=}CH^{38}Cl$. Addition to propyne by ^{38}Cl is 1.9 +- 0.2 times as rapid at 25°C as reaction with HI to form $H^{38}Cl$. Half of the $C_3H_4{}^{38}Cl^*$ radicals formed by thermal ^{38}Cl addition to propyne are collisionally stabilized by $CClF_3$ at a pressure of 250 +- 50 torr. This half-stabilization pressure is approximately equal to that found for $C_3H_6{}^{38}Cl^*$ radicals from ^{38}Cl plus propene and a factor of 3 slower than for $C_2H_4{}^{38}Cl^*$ from ^{38}Cl plus C_2H_4.

PROPERTIES OF RADIOACTIVE MATERIALS

REFER ALSO TO CITATION(S) 37693, 38420, 38515, 38531

38495 (K/ET—594) **Extrapolation to the U-F system from the Mo-F system.** Leitnaker, J.M. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 27 Aug 1980. Contract W-7405-ENG-26. 13p. NTIS, PC A02/MF A01.

A review of the thermodynamic data on the U-F system, a summary of the thermodynamic data on the Mo-F system, and a comparison of the two systems, and speculation about missing entities are presented in this report. The thermodynamic data include: entropies, melting points, enthalpies of formation of the established solid uranium and molybdenum fluorides; and entropies and enthalpies of formation of gaseous uranium and molybdenum fluoride. Upon concluding his studies, the author speculated on the presence of compounds such as U_2F_{11} and U_4F_{23} in the solid state, and U_3F_{15}, U_4F_{20}, and U_5F_{25} in the gaseous state. None of these have been observed.

38496 (ORNL—5665, pp 68-80) **Chemistry of transuranium elements and compounds.** Jul 1980.

In Chemistry Division annual progress report, February 29, 1980.

Attempts to prepare $BkBr_2$ and E_2 (IV) failed. Effects of decay on valence are being studied for $^{253}Es \rightarrow {}^{249}Bk \rightarrow {}^{249}Cf$ and $^{244}Cm \rightarrow {}^{240}Pu$. During the preparation of transplutonium elements, the divalent forms of Cf and Sm were observed only in very small samples. Enthalpies of evaporization were measured for ^{249}Cf and ^{249}Bk. Enthalpies of solution in 1.0N HCl were measured for ^{243}Am. Magnetic susceptibilities of ^{248}Cm and ^{249}Bk were measured at 0 to 350°K. X-ray diffraction of ^{243}Am at 125 to 177 kbar showed a new structure of the orthorhombic α-U type. A spectroelectrochemical investigation is underway of unusual oxidation states of the lanthanides and actinides. 7 figures, 2 tables. (DLC)

38497 (ORNL-tr—4671) **Coprecipitation of uranium (VI) with ferric hydroxide during complex formation.** Novikov, A.I.; Tikhomirova, V.I. Translated from *Izv. Vyssh. Uchebn. Zaved., Khim. Khim. Tekhnol.;* **6**: No. 3, 377-384(1963). 16p. NTIS, PC A02/MF A01.

The precipitation of uranium within a wide pH range in 1 M ammonium nitrate solution at various uranium concentrations and the coprecipitation of uranium with ferric hydroxide in the pH region from 4 to an alkaline medium (5 M KOH) in the presence of ammonium nitrate, ammonium sulfate, ammonium carbonate, and hydrogen peroxide were studied. The coprecipitation of uranium with ferric hydroxide is a complicated and varied process that depends on a number of conditions: the pH of the medium, the uranium concentration, the saline composition of the solutions, etc. Coprecipitation of uranium with ferric hydroxide may be due to the following major processes: the coordination affixture of polynuclear hydroxy-cations of uranyl by the carrier surface via OH-bridges in the region pH < 7; the coprecipitation, along with ferric hydroxide, of sparingly soluble precipitates of uranyl hydroxide, polyuranates, diuranates, and other uranyl compounds in the pH regions in which they exist; and the affixture of anions and polyanions containing uranium to ferric hydroxide by way of a hydrogen bond and by the formation of coordination anionic bonds with metal ions in the carrier precipitate. The formation of complex anions of uranyl with carbonate and sulfate ions in which the anions occupy the coordination sphere of the uranyl and prevent the appearance of OH^- and hydrogen bonds with the carrier precipitate leads to a decrease in the sorption of uranium by ferric hydroxide.

38498 Preparation and properties of uranocenecarboxylic esters. Streitwieser, A. Jr. (Univ. of California, Berkeley); Burghard, H.P.G.; Morrell, D.G.; Luke, W.D. *Inorg. Chem.;* **19**: No. 7, 1863-1866(Jul 1980).

Several esters of uranocenoic acid and 1,1'-uranocenedioic acid were prepared from the corresponding cyclooctatetraene esters by reduction with potassium naphthalide followed by reaction with UCl_4. The esters are hydrolyzed immediately by hydroxylic solvents. The visible spectra show the hypsochromic shifts expected for electron-withdrawing groups. Infrared and NMR spectra are also reported together with the magnetic susceptibility. These compounds appear to have substantially more ionic metal-ligand bonding than alkyluranocenes, but such bonding is still substantial.

38499 Preparation of Oxobis(dithiolato) complexes of technitium(V) and rhenium(V). Davison, A. (Massachusetts Inst. of Technology, Cambridge); Orvig, C.; Trop, H.S.; Sohn, M.; DePamphilis, B.V. Contract E(11-1)4115. *Inorg. Chem.;* **19**: No. 7, 1988-1992(Jul 1980).

A series of oxobis(dithiolato)metalate(V) complexes of technetium and rhenium have been synthesized and studied by various physical techniques, including infrared and optical spectroscopy and cyclic voltammetry. Physical properties of the complexes are compared with respect to periodicity and the substituents on the ligand backbones. The stability of these five-coordinate complexes contradicts the current notion that Tc(V) and Re(V) complexes are inherently unstable in aqueous solution.

38500 Technetium cyanide chemistry: synthesis and characterization of technetium(III) and -(V) cyanide complexes. Trop, H.S. (Massachusetts Inst. of Technology, Cambridge); Jones, A.G.; Davison, A. Contract E(11-1)4115. *Inorg. Chem.;* **19**: No. 7, 1993-1997(Jul 1980).

Several new technetium cyanide complexes have been prepared and characterized. The reaction of ammonium hexaiodotechnetate(IV) with potassium cyanide in refluxing aqueous methanol under nitrogen yields potassium heptacyanotechnetate(III) dihydrate, $K_4Tc(CN)_7.2H_2O$ (1). Infrared and Raman measurements indicate that 1 has a pentagonal bipyramidal structure (D/sub 5h/) in both solid and solution. Aqueous solutions of 1 are air sensitive, decomposing to potassium oxopentacyanotechnetate(V) tetrahydrate, $K_2TcO(CN)_5.4H_2O$ (2). This species can also be prepared from the reaction of $TcO_2.xH_2O$ with hot aqueous potassium cyanide solutions. Hydrolysis of 2 in water yields potassium trans-dioxotetracyanotechnetate(V), $K_3TcO_2(CN)_4$ (3). Preparation of 3 can also be achieved from the treatment of $[TcO_2(Py)_4]ClO_4.2H_2O$ with aqueous potassium cyanide. Infrared and Raman measurements on 3 are consistent with the proposed trans-dioxo (D/sub 4h/) structure. Reaction of the oxotetrachlorotechnetate(V) anion, $TcOCl_4$, with potassium cyanide in methanol produces trans-oxomethoxytetracyanotechnetate(V). $[TcO(OMe)(CN)_4]$ (4). The full details of the synthesis and characterization of these interesting technetium(III) and -(V) complexes, as well as observations on the infrared and Raman spectra of trans-dioxo metal complexes and the hydrolysis of species 2, are presented.

38501 Bis(eta^8-1,3,5,7-tetramethylcyclooctatetraene) compounds of protactinium, neptunium, and plutonium. Solar, J.P.; Burghard, H.P.G.; Banks. R.H.; Streitwieser, A. Jr.; Brown, D. (Univ. of California, Berkeley). Contract W-7405-ENG-48. *Inorg. Chem.;* **19**: No. 7, 2186-2188(Jul 1980).

X-ray powder diffraction patterns have shown that bis(cyclooctatetraene)-actinide(IV) complexes are all structurally and chemically similar. This suggests that the same bonding scheme prevails throughout these actinide(IV)-COT series and the unusual degree of covalency demonstrated by the Moessbauer spectra of $Np(RC_8H_7)_2$ may be a common property. However, comparisons across the actinide series are hampered by the lack of data on protactium complexes. Therefore, a new study of the synthesis of bis(cyclooctatetraene) protactinium was undertaken. The reaction of the tetramethylcyclooctatetraene dianion ($TMCOT^{2-}$) with $PaCl_4$, gave a light brown solution from which $Pa[(CH_3)_4C_8H_4]_2$ can be isolated in low yield. This compound, which has not previously been prepared, was soluble in tetrahydrofurn (THF) and slightly soluble in benzene, and it was identified by its x-ray power diffraction pattern. In addition, a new synthetic route to actinocenes was developed by using neptunium and plutonium borohydride complexes $M(BH_4)_4$. These volatile air-sensitive compounds are readily soluble in organic solvents and were allowed to react with cyclooctate-

traene dianions in THF. $Np(TMCOT)_2$, which has previously been prepared from $NpCl_4$, is readily isolated by recrystallization from THF. X-ray powder patterns show that Pa and Pu complexes are isostructural with $Np(TMCOT)_2$.

38502 X-ray photoelectron spectroscopy study of the chemisorption of water on uranium and thorium and oxygen on uranium. Nornes, S.B.; Meisenheimer, R.G. (Univ. of California, Livermore). *Surf. Sci.;* **88**: 191-203(1979).

The initial stages of water and oxygen adsorption on clean uranium and thorium and oxygen adsorption on uranium has been studied by x-ray photoelectron spectroscopy. These measurements are made in the vicinity of 120 K; in some cases the effect of temperature was followed up to 500 K. Three oxygen (1s) photoelectron peaks are observed for water adsorbed on uranium and thorium. All three peaks have binding energies different from the adsorption of oxygen. The uranium and thorium (4f/sub 7/2/) lines also have different binding energies for water adsorption than for oxygen adsorption. Oxygen and an OH complex combine with uranium and thorium in a complex way, precluding the initial formation of simple oxides and confirming the importance of OH in the interaction of water with uranium and thorium.

RADIOISOTOPE PRODUCTION

REFER ALSO TO CITATION(S) 37692

38503 (BNL—28275) **Iodine-123 generator/iodination kit: a preliminary report.** Richards, P.; Prach, T.; Srivastava, S.C.; Meinken, G.E. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 6p. (CONF-800974—1). NTIS, PC A02/MF A01.

From International symposium on radioiodines; Banff, Alberta, Canada (13 Sep 1980).

Preliminary results are described of a xenon-123 filled device to serve as a combination iodine-123 generator/iodination kit. Xenon-123 is produced in the Brookhaven Linac Isotope Producer (BLIP) by the reaction $^{127}I(p, 5n)^{123}Xe$. The device consists of a small glass ampoule containing an internal glass breakseal and a flanged neck on which is crimped a multi-injection type septum. The ampoule contains a hydrogen sulfide atmosphere to assure that the iodine generated from the decay of the xenon is in the form of iodide. Following an adequate period for xenon-123 to decay (this period can be used for shipment), a needle is forced through the septum breaking the seal and residual gases are pumped off. The iodine-123 in the form of iodide can then be rinsed from the ampoule with any desired solvent or reagent added directly to the device to carry out an iodination in an enclosed environment. Preliminary results of both iodine recovery and iodinations have been promising.

38504 (CONF-800814—19(Draft)) **Preparation of curium-americium oxide microspheres by resin-bead loading.** Chattin, F.R.; Benker, D.E.; Lloyd, M.H.; Orr, P.B.; Ross, R.G.; Wiggins, J.T. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 26p. NTIS, PC A03/MF A01.

From 180. American Chemical Society meeting/2. chemical congress of the North American Continent; San Francisco, CA, USA (24 Aug 1980).

Resin-bead loading and calcination techniques have been used to produce all curium and americium oxide feed material (about 2.2 kg) for HFIR targets since 1971. The process based on Dowex 50W resin has progressed from a series of test runs, through special production runs, into routine production in permanent equipment beginning in 1975. Key attributes of this process are its reliability, high yields, and ease of operation. The process is suited for remote operation in hot cells. Yields approaching 95% are routinely obtained and only one unacceptable product has been generated during routine production operations. There have been no problems in fabricating targets from this oxide or in the subsequent irradiation of these targets. The present scale of production of 150 to 250 g/y supplies the present need and is comparable with the level of other chemical process operations at TRU. Since the annual production is accomplished in two 8 to 12 day periods, there has been no reason to consider further scale-up. However, the rate of production could easily be doubled by simply adding a second set of calcination equipment.

COMBUSTION, PYROLYSIS, AND HIGH-TEMPERATURE CHEMISTRY

REFER ALSO TO CITATION(S) 38476

38505 (SAND—80-0081) **Theory of droplet combustion at high pressures.** Baer, M.R. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1980. Contract AC04-76DP00789. 86p. NTIS, PC A05/MF A01.

A theory of liquid droplet combustion at subcritical, near-critical, and supercritical pressures is presented. At high pressures, the theoretical model is composed of two separate parts. During droplet heatup when the temperature within the droplet is below its thermodynamic critical temperature, a quasi-steady diffusion film model is used. Incorporated in this model are the effects of nonideal gas behavior, including gas absorption in the liquid phase and the effect of droplet surface recession. When the droplet temperature exceeds the critical temperature limit, the diffusion is considered to be entirely time varying and the previous model provides the initial conditions to the pure diffusion-controlled vaporization. A Green's function integral solution to the diffusion equation is used to deduce the supercritical combustion characteristics. The effects of convection are introduced by multiplicative Frossling corrections to the diffusion film coefficients. Evaporization and combustion characteristics of n heptane in high pressure air are compared with existing data. Excellent agreement with experimental results is demonstrated. Results show that in the near critical pressure regime, a significant amount of droplet mass is vaporized before the droplet reaches a critical temperature. It is also shown that at all pressures a modification of the film coefficients yields meaningful estimates of combustion burn time. The presence of convection at supercritical pressures causes the combustion burn time to be weakly dependent on pressure and a significant departure from the predictions of earlier theories is indicated.

38506 (SAND—80-1916C) **Circulation and coalescence within a vaporizing emulsified fuel droplet.** Baer, M.R.; Sheffield, S.A.; Denison, G.J. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 4p. (CONF-801118—1). NTIS, PC A02/MF A01.

From Fall technical meeting eastern section: the Combustion Institute; Princeton, NJ, USA (12 Nov 1980).

A droplet of emulsified fuel (hexadecane, with 30% dispersed water and 2% surfactant) was supported by a vapor film between the droplet and a polished hot surface. Overlighting with a laser was used. During vaporization of $\sim$ 2000 μm droplet, rapid internal circulation caused coalescence of the dispersed water droplets. Convective velocities are 0.2 to 0.5 m/s. During circulation, these droplets move directly along the fuel surface and are not preferentially distilled from the droplet. Coalescence of the water continues until all the water is in a single lump, and then this lump falls to the base of the droplet. (DLC)

38507 (SAND—80-8231) **Fundamental combustion and diagnostics research at Sandia. Progress report, April-June 1980.** Gusinow, M.A. (ed.). (Sandia Labs., Albuquerque, NM (USA)). Sep 1980. Contract AC04-76DP00789. 32p. NTIS, PC A03/MF A01.

The combustion research emphasizes basic research into fundamental problems associated with combustion. The overall program addresses detailed chemistry of combustion, fundamental processes associated with laminar and turbulent flames, development of research techniques specifically applicable to combustion environments, and operation of the user-oriented Combustion Research Facility. The first section of this report contains activities in Combustion Research, the second section contains activities in Molecular Physics and Spectroscopy, and the third section contains activities in Diagnostics Research.

38508 Experimental and numerical investigation of confined laminar diffusion flames. Mitchell, R.E.; Sarofim, A.F.; Clomburg, L.A. (Sandia Lab, Livermore, Calif). *Combust. Flame;* **37**: No. 3, 227-244(Apr 1980).

A laminar methane-air diffusion flame was extensively probed for its temperature, velocity, and stable species' concentration profiles. The data obtained were used to validate a theoretical model capable of characterizing flame macrostructure and useful in predicting the effects of flow rate, equivalence ratio, fuel and air preheat, and nozzle size on the thermal and aerodynamic fields established in confined, axisymmetric, laminar diffusion flames. 17 refs.

38509 Droplet combustion in a reactive environment. Botros, P.; Law, C.K.; Sirignano, W.A. (Northwest Univ, Evanston, Ill). *Combust. Sci. Technol.;* **21**: No. 3-4, 123-130(1980).

The transient processes of evaporation, ignition, and combustion of a fuel droplet in a hot, reactive fuel-oxidizer environment simulating the spray interior was studied numerically, with emphasis on the relative importance of diffusional burning in the droplet vicinity and premixed burning in the ambience. It is shown that for a fuel-lean environment diffusional burning is generally possible and is initiated rapidly, whereas for a fuel-rich environment only premixed burning is possible. For a sufficiently reactive environment one of the reactants is rapidly depleted such that during most of the droplet lifetime the environment is really nonreactive. A new transient process, involving the need to build up the fuel vapor concentration in the droplet vicinity form an initial state of low concentration, has also been identified to be important during droplet combustion and warrants further study. 16 refs.

ENGINEERING

GENERAL ENGINEERING

REFER ALSO TO CITATION(S) 37538

FACILITIES AND EQUIPMENT

38510 (COO—2733-25) **Finite element analysis of time-dependent inelastic deformation in the presence of transient thermal stresses.** Mukherjee, S.; Morjaria, M. (Cornell Univ., Ithaca, NY (USA). Dept. of Theoretical and Applied Mechanics). Jan 1980. Contract AS02-76ER02733. 26p. NTIS, PC A03/MF A01.

A finite element formulation for the solution of time-dependent inelastic deformation problems for metallic structures, in the presence of transient thermal stresses, is presented. A rate formulation of the equations is used and any of a number of recently proposed combined creep-plasticity constitutive models with state variables can be adopted to describe material behavior. The computer program developed can solve planar (plane strain and stress) and axisymmetric problems. Using one of the above mentioned constitutive models, numerical results are presented for several illustrative problems, and comparisons of results, using either the quasi-steady or the unsteady diffusion equation for the determination of the temperature field, are carried out.

38511 (DOE/ER/02733—26) **Boundary element formulation for planar time-dependent inelastic deformation of plates with cutouts.** Mukherjee, S.; Morjaria, M. (Cornell Univ., Ithaca, NY (USA). Dept. of Theoretical and Applied Mechanics). Feb 1980. Contract AS02-76ER02733. 39p. NTIS, PC A03/MF A01.

A boundary element formulation for planar, time-dependent, inelastic deformation problems for bodies with cutouts is presented in this paper. A stress function description for these nonlinear problems leads to a nonhomogeneous biharmonic equation for the stress function rate. An integral representation of the solution uses modified kernels which guarantee that the cutout boundary is traction free for all time. This incorporation of the effect of the cutout on the stress field into the kernels leads to an accurate determination of stresses in the near field of the cutout. Illustrative analytical examples for circular plates with circular cutouts are presented in this paper. In a companion paper, numerical solutions are presented for problems of finite plates with very narrow elliptic cutouts. These problems are of considerable importance in inelastic fracture.

38512 (DOE/ER/02733—27) **Numerical analysis of planar, time-dependent inelastic deformation of plates with cracks by the boundary element method.** Morjaria, M.; Mukherjee, S. (Cornell Univ., Ithaca, NY (USA). Dept. of Theoretical and Applied Mechanics). Feb 1980. Contract AS02-76ER02733. 41p. NTIS, PC A03/MF A01.

A boundary element formulation using augmented kernels, for planar time-dependent inelastic deformation problems for bodies with cutouts, has been presented in a companion paper. The primary advantage of this formulation is that the effect of the cutout is incorporated in the kernels and the cutout boundary need not be modelled in a numerical solution procedure. In this paper, the specific kernels for plates with elliptic cutouts are first derived. These kernels are then used to obtain numerical solutions for time-dependent stress fields near stationary crack tips in finite plates. A crack is modelled as a very narrow ellipse and both remote tensile (mode one) and remote shear (mode two) loadings are considered. The deformation of the plate material is assumed to be described either by the equations of power law creep on the combined creep-plasticity constitutive model of Hart.

38513 (DOE/ER/02733—28) **Boundary element analysis of time-dependent inelastic deformation of cracked plates loaded in anti-plane shear.** Mukherjee, S.; Morjaria, M. (Cornell Univ., Ithaca, NY (USA). Dept. of Theoretical and Applied Mechanics). Jul 1980. Contract AS02-76ER02733. 37p. NTIS, PC A03/MF A01.

A boundary element analysis, for determining stresses in planar cracked bodies undergoing Mode I or Mode II inelastic deformation, has been recently published by the present authors. One primary advantage of this formulation is that the effect of the crack is incorporated in the kernels of the integral equations. Thus, traction free conditions on the crack boundary are satisfied without discretization of this boundary in a numerical calculation procedure. The inelastic deformation of cracked plates loaded in anti-plane shear (Mode III) is studied in this paper. Modified kernels are used so that the only unknowns in the integral equations are source strengths on the outer boundary of the plate. It is proved that this formulation guarantees traction free cracks as well as single valued displacements on the crack boundary. Numerical results for stresses are presented for various loading histories with the plate material described by an elastic-nonlinear power law creep constitutive model and a stationary crack modelled as a very thin ellipse.

38514 (DOE/ER/02733—29) **Inelastic bending of a nickel beam at several temperatures: experiment and prediction.** Mautz, J.A.; Hart, E.E. (Cornell Univ., Ithaca, NY (USA). Dept. of Theoretical and Applied Mechanics). Jul 1980. Contract AS02-76ER02733. 31p. NTIS, PC A03/MF A01.

The results of an experiment on the bending response of a nickel prismatic beam under four point loading at 25°C, 200°C, and 300°C are described. The specimens have been subjected to histories of steady applied moment with a sequence of step changes both positive and negative. The measured results are compared with predictions based on Hart's constitutive equations. The experimental conditions and procedures are described. The experiment and the predictions are compared with prior studies.

38515 (GEPP-TIS—526) **Ultrasonic cleaner evaluation.** Gillespie, T.J. (General Electric Co., St. Petersburg, FL (USA). Neutron Devices Dept.). 8 Oct 1980. Contract AC04-76DP00656. 22p. NTIS, PC A02/MF A01.

A method has been developed to evaluate the capabilities of ultrasonic cleaners. This method utilizes a ceramic plate on which a metallized coating has been deposited. The plate is immersed in a beaker filled with DI water and a few drops of liquid detergent. The plate is then subjected to a two-minute cleaning cycle. Measurement of the amount of metallized coating that has been removed is determined with an image enhancement system. Use of this test has also revealed several factors that influence cleaning capabilities. These include system frequency, use of a wetting agent in the bath, bath temperature, fixture materials and fixture mounting.

38516 (SAND—80-2093C) **Conservatism in least favorable response analysis and testing.** Paez, T.L. (New Mexico Univ., Albuquerque (USA). Dept. of Civil Engineering). 1980. Contract AC04-76DP00789. 112p. (CONF-801033—2). NTIS, PC A06/MF A01.

From Shock and vibration symposium; San Diego, CA, USA (21 Oct 1980).

In order to assure that mechanical structures can meet design requirements it is desirable to test a structure using an input which is conservative but not a severe overtest. One method available for the specification of shock tests is the method of least favorable response. This method can be used analytically or in the laboratory and is guaranteed to provide tests which are conservative, at least in one sense. When the impulse response function, or equivalently the frequency response function, is available between a point of interest on a structure and the input point of the structure, and when we know the real function which envelops the modulus of the Fourier transform of all possible inputs which might excite the structure, then the method of least favorable response can be used to find an upper bound on the response which the point of interest on the structure can realize. We use this in the analysis of structural peak response. In the laboratory the least favorable response is generated experimentally, for example, by testing the structural unit on a shake table. If the structure survives the laboratory test, then we assume that it could survive any input in the class of inputs whose Fourier transform moduli are enveloped by the function used in the analysis. The objective of this study was to analyze the inherent conservatism of the method of least favorable response. A technique that can be used to do this is demonstrated. First, the method of least favorable response is reviewed and how it is used analytically and experimentally is demonstrated. Next the technique used to measure the conservatism in a least favorable response test is developed. Finally, the method is applied in some numerical examples where the degree of conservatism in the tests of some specific structures is measured. (LCL)

38517 (UCRL—50025-80-1) **Electronics Engineering Department. Quarterly report No. 1, 1980.** (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Apr 1980. Contract W-7405-ENG-48. 33p. NTIS, PC A03/MF A01.

Each of the six sections was abstracted and indexed individually for EDB/ERA. (JGB)

38518 (UCRL—50025-80-1, pp 1-4) **Projectile launched from electromagnetic railgun achieves fastest velocity to date.** 1 Apr 1980.

In Electronics Engineering Department. Quarterly report No. 1, 1980.

On March 14, 1980, a joint team of researchers from LASL and LLNL used an electromagnetic railgun to accelerate a 3.1-g projectile to a velocity of 9.9 km/s and a kinetic energy of ~ 150 kJ. This is the fastest and most energetic railgun-launched projectile known to date.

38519 (UCRL—52960-1) **Technology of machine tools. Volume 1. Executive summary.** Sutton, G.P. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). Oct 1980. Contract W-7405-ENG-48. 65p. NTIS, PC A04/MF A01.

The Machine Tool Task Force (MTTF) was formed to characterize the state of the art of machine tool technology and to identify promising future directions of this technology. This volume is one of a five-volume series that presents the MTTF findings; reports on various areas of the technology were contributed by experts in those areas.

38520 (UCRL—52960-4) **Technology of machine tools. Volume 4. Machine tool controls.** (California Univ., Livermore (USA). Lawrence Livermore Lab.). Oct 1980. Contract W-7405-ENG-48. 376p. NTIS, PC A17/MF A01.

The Machine Tool Task Force (MTTF) was formed to characterize the state of the art of machine tool technology and to identify promising future directions of this technology. This volume is one of a five-volume series that presents the MTTF findings; reports on various areas of the technology were contributed by experts in those areas.

38521 (UCRL—84237) **Design and performance of a high pressure spray cleaning system.** Stowers, I.F. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 10 Sep 1980. Contract W-7405-ENG-48. 15p. (CONF-800978—1). NTIS, PC A02/MF A01.

From 5. international symposium on contamination control of ICCCS; Munich, F.R. Germany (15 Sep 1980).

A very high velocity liquid spray has been previously shown to be an extremely effective method for removing small solid insoluble particles from both polished glass and metallic surfaces. In direct comparisons spraying has been shown to be at least two orders of magnitude more effective than ultrasonic cleaning. A gloved-box enclosure is discussed that has been designed and fabricated to allow this high pressure 7MPa spray cleaning system to be safely implemented as a routine procedure for cleaning glass-laser hardware. The system includes a recirculation system to allow 90% recovery and reuse of the fluorocarbon solvent. An additional feature is the ability to pass the wasing effluent through a membrane filter which after microscopic examination allows verification of cleanliness. The high pressure spray cleaning system described has proven to be extremely effective at removing small insoluble particles from surfaces. It has been shown to be able to remove in excess of 99.5% of greater than 5 μm diameter particles from metal and glass surfaces. The high pressure spray can be safely applied to routine cleaning by using an enclosed gloved-box. A large fraction of the solvent can be recovered by collecting the spray effluent, diftilling it, and passing it through a membrane filter before reuse. By including a boiling solvent sump in the gloved spray box all air containing water vapor can be excluded. This prevents condensation of the water vapor during spraying which results from a lowering of the spray temperature due to rapid evaporation of a portion of the spray. (LCL)

38522 (UCRL—84538) **Optical technician for government laboratories.** Sanger, G.M.; Brown, N.J. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 24 Sep 1980. Contract W-7405-ENG-48. 12p. (CONF-800982—1). NTIS, PC A02/MF A01.

From Huntsville electro-optical technical symposium; Huntsville, AL, USA (29 Sep 1980).

The training and expertise of optical technicians employed at the Lawrence Livermore National Laboratory for the purpose of fabricating, coating, and precisely controlling the quality of optical equipment used in the Laboratory are discussed. (LCL)

38523 (Y—2209) **Electrochemical machining in-process data collection and control.** Neal, R.E. (Oak Ridge Y-12 Plant, TN (USA)). Sep 1980. Contract W-7405-ENG-26. 27p. NTIS, PC A03/MF A01.

Electrochemical machining (ECM) is a fast and efficient method to fabricate intricate metal parts. However, tooling is often expensive; and electical power consumption is relatively high. The precision of an ECM process is dependent upon several variables which often cannot be predicted in the initial tool design. This leads to iterative tool adjustments until the desired level of precision is achieved. A system was devised to use a computer for collecting data from the ECM process and for monitoring and controlling ECM operations. It is believed that these data collections and analyses will lead to the formulation of algorithms to produce parts with better tolerances and will allow more efficient uses of the ECM machines. One algorithm has been developed to allow the efficient ECM of large-surface-area parts. Such programs and equipment will enhance the competitive position of the ECM process in machining applications previously performed by more conventional methods while minimizing electrical power consumption.

38524 (Y—2232) **F-111 windscreen machining. Final report.** Gerth, H.L.; Brown, R.J. (Oak Ridge Y-12 Plant, TN (USA)). 22 Sep 1980. Contract W-7405-ENG-26. 22p. NTIS, PC A02/MF A01.

Studies were conducted to determine the feasibility of improving the optical image transmitted through a military aircraft windscreen by using single-point diamond turning. Reduced warpage (waviness) of the windscreen surfaces ensures that a more accurate optical image is presented to the aircraft pilot. Machining the acrylic surface was accomplished with slightly impared image transmissibility. The use of this technique as a potential production process is discussed.

38525 (UCRL-Trans—11621) **Streak recordings of dynamic forming of metal liners.** Blankenagel, H.J.; Ludwig, D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Aug 1980. Translated from proceedings of the 13th international Congress on high-speed photography and photonics, Tokyo, Japan, 1978, pp 801-804. 10p. NTIS, PC A02/MF A01.

The presented method for recording fast events using the streak technique was developed for an investigation of the deformability of metal liners. The object of the study was the high energy rate forming process of different metal liners produced by explosively generated shock waves. Streak records of the axially symmetrical collapsing and axially accelerated liner, forming a projectile, made it possible to get a quantitative analysis of the forming process in a 5 x 10^{-6} sec period of time. By an adequate evaluation and calculation method it was possible to describe a high velocity forming process with rates up to 2000 m/sec.

CRYOGENIC AND SUPERCONDUCTING EQUIPMENT AND DEVICES

REFER ALSO TO CITATION(S) 38201, 38381, 39146, 39147, 39149, 39150, 39151, 39152, 39154, 39155

38526 (CONF-800980—11) **Parametric study of the stability margins of cable-in-conduit superconductors: experiment.** Lue, J.W.; Miller, J.R. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 4p. NTIS, PC A02/MF A01.

From Applied superconductivity conference; Santa Fe, NM, USA (29 Sep 1980).

In a previous experiment on the stability of cable-in-conduit superconductors, we sometimes observed multivalued stability margins, which we attributed to strong heating-induced transient flows. We proposed a schematic theory from which we derived a scaling relation for the limiting current below which the stability margin is always singlevalued. Measurements at different magnetic fields are used to test the scaling with critical temperature and resistivity. We also examine the scaling with heated length and heat pulse duration. The results of these experiments are given and compared with theory.

38527 (CONF-800980—12) **Magnetization of in situ multifilamentary superconducting Nb_3Sn-Cu composites.** Shen, S.S.; Verhoeven, J.D. (Oak Ridge National Lab., TN (USA); Ames Lab., IA (USA)). 1980. Contract W-7405-ENG-26. 3p. NTIS, PC A02/MF A01.

From Applied superconductivity conference; Santa Fe, NM, USA (29 Sep 1980).

Magnetic properties are reported for in situ superconducting Nb_3Sn composites that have exhibited attractive electrical properties and superior mechanical characteristics. Magnetization measurements were conducted up to 4 T at 4.2 K on a variety of samples of different sizes and twist pitches, and the results are presented in absolute M-H curves and losses per cycle. It is observed that the magnetization of such composites is generally proportional to the size of the wire (~ 0.25 to 0.51 mm) rather than the fiber size (~ 10^{-7} m), which indicates a strong coupling effect among Nb_3Sn fibers.

38528 (LBL—10552) **TPC magnet cryogenic system.** Green, M.A.; Burns, W.A.; Taylor, J.D.; Van Slyke, H.W. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1980. Contract W-7405-ENG-48. 118p. NTIS, PC A06/MF A01.

The Time Projection Chamber (TPC) magnet at LBL and its compensation solenoids are adiabatically stable superconducting solenoid magnets. The cryogenic system developed for the TPC magnet is discussed. This system uses forced two-phase tubular cooling with the two cryogens in the system. The liquid helium and liquid nitrogen are delivered through the cooled load by forced tubular flow. The only reservoirs of liquid cryogen exist in the control dewar (for liquid helium) and the conditioner dewar (for liquid nitrogen). The operation o these systems during virtually all phases of system operation are described. Photographs and diagrams of various system components are shown, and cryogenic system data are presented in the following sections: (1) heat leaks into the TPC coil package and the compensation solenoids; (2) heat leaks to various components of the TPC magnet cryogenics system besides the magnets and control dewar; (3) the control dewar and its relationship to the rest of the system; (4) the conditioner system and its role in cooling down the TPC magnet; (5) gas-cooled electrical leads and charging losses; and (6) a summation of the liquid helium and liquid nitrogen requirements for the TPC superconducting magnet system.

PROTECTIVE STRUCTURES AND EQUIPMENT

38529 **Laser safety eyewear update.** Winburn, D.C. (Los Alamos Scientific Lab., NM). *Electro-Opt. Syst. Des.;* 1-5(Jan 1979).

The design, performance and uses of laser protective eyewear which is currently available is briefly reviewed. (LCL)

HANDLING EQUIPMENT AND PROCEDURES

REFER ALSO TO CITATION(S) 37723

38530 (CONF-800431—6) **Nuclear safety guide TID-7016 Revision 2.** Thomas, J.T. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 9p. NTIS, PC A02/MF A01.

From Nuclear criticality safety topical meeting; El Paso, TX, USA (8 Apr 1980).

The present revision of TID-7016 Nuclear Safety Guide is discussed. This Guide differs significantly from its predecessor in that the latter was intentionally conservative in its recommendations. Firmly based on experimental evidence of criticality, the original Guide and the first revision were considered to be of most value to organizations whose activities with fissionable materials were not extensive and, secondarily, that it would serve as a point of departure for members of established nuclear safety teams, experienced in the field. The reader will find a significant change in the character of information presented in this version. Nuclear Criticality Safety has matured in the past twelve years. The advance of calculational capability has permitted validated calculations to extend and substitute for experimental data. The broadened data base has enabled better interpolation, extension, and understanding of available, information, especially in areas previously addressed by undefined but adequate factors of safety. The content has been thereby enriched in qualitative guidance. The information inherently contains, and the user can recapture, the quantitative guidance characteristic of the former Guides by employing appropriate safety factors. In fact, it becomes incumbent on the Criticality Safety Specialist to necessarily impose safety factors consistent with the possible normal and abnormal credible contingencies of an operation as revealed by his evaluation. In its present form the Guide easily becomes a suitable module in any compendium or handbook tailored for internal use by organizations. It is hoped the Guide will continue to serve immediate needs and will encourage continuing and more comprehensive efforts toward organizing nuclear criticality safety information.

38531 (CONF-800542—5(Draft)) **Decontamination of concrete surfaces in Building 3019, Oak Ridge National Laboratory.** Parrott, J.R. Sr. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 20p. NTIS, PC A02/MF A01.

From Concrete decontamination workshop; Seattle, WA, USA (28 May 1980).

This building was built in 1943 to serve as a pilot plant for separating isotopes from irradiated fuels. A chemical explosion leading to widespread Pu contamination occurred on Nov. 20, 1959, and the steps taken to treat the building afterwards are discussed, in particular the floor and the cells. The experience shows how hard it is to decontaminate concrete; smooth coatings should be utilized. (DLC)

SHIPPING CONTAINERS

38532 (DP—1536) **Rail tiedown tests with heavy casks for radioactive shipments.** Petry, S.F. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Aug 1980. Contract AC09-76SR00001. 56p. NTIS, PC A04/MF A01.

A rail tiedown test program was conducted at the Savannah River Plant in July and August 1978. For each test, a 40- or 70-ton cask was secured on a railcar. The railcar was pushed to speeds up to 11 mph and allowed to couple to parked railcars simulating ordinary railyard operations. The test car carrying the cask was heavily instrumented to measure the accelerations and forces generated at strategically selected places. Eighteen test runs were made with different combinations of railcars, couplers, casks, speeds, and tiedown configurations. The major objectives of the test program were to (1) provide test data as a basis to develop a tiedown standard for rail cask shipments of radioactive materials and (2) collect dynamic data to support analytical models of the railcar cask tiedown system. The optimum tiedown configuration demonstrated for heavy casks was a combination of welded, fixed stops to secure the cask longitudinally and flexible cables to restrain vertical and lateral cask movement. Cables alone were inadequate to secure a heavy cask to a standard railcar, and bolting was found disadvantageous in several respects. The use of cushioning coupler mechanisms dramatically reduced the tiedown requirements for the rail coupling operation. The test program and general conclusions are discussed.

38533 (GEFR-SP—204) **Considerations for designing a spent-fuel shipping system for commercial LMFBR plants.** Davis, C.R. (General Electric Co., Sunnyvale, CA (USA). Advanced Reactor Systems Dept.). 31 Jul 1980. Contract AT03-76SF70030. 28p. (CONF-801115—1). NTIS, PC A03/MF A01.

From 6. international symposium on packaging and transporting radioactive material; Berlin, F.R. Germany (10 Nov 1980). Thesis.

This paper identifies many factors which influence the design of a spent-fuel shipping system for commercial Liquid Metal Fast Breeder Reactors (LMFBR's). Appropriate consideration of these factors will result in a cost effective shipping system that maximizes safety and reliability and minimizes shipping time and radiation exposure to personnel. Existing spent-fuel shipping equipment is not appropriate for servicing future commercial LMFBR's. This is due primarily to two present-day conditions: first, without reprocessing and recycle in the US, there are presently no economic incentives for rapid low-cost spent-fuel shipping; and second, the early LWR's and LMFBR's were designed, and many built, without a spent-fuel shipping system design. LMFBR facilities can be designed to eliminate the removal of a 100 ton shipping cask from its railroad transporter for loading and the contamination of the cask's exterior surfaces and the subsequent cleaning. Loading of the shipping cask can be accomplished remotely, which eliminates almost all personnel exposure to radiation. Shipping spent-fuel in sodium eliminates a sodium cleaning operation at the reactor, saves time in preparing spent-fuel for shipment and reduces the accumulation of radioactive liquid waste at the reactor. A cask and canister design that provides double containment of spent-fuel during transit enhances safety and satisfies regulatory requirements. Sealed sodium-filled canisters for individual fuel assemblies provide primary containment. The sealed shipping cask closure provides secondary containment and heat dissipation. Criteria for minimizing fuel inventory costs require that spent-fuel shipping be integrated into the overall refueling and fuel recycle schedules. Cost savings are obtained by rapid cask turnaround and shipping fuel and radial blanket assemblies together in the same cask.

38534 (KY—697) **License application for type 48HX cylinder for shipment of natural assay UF_6.** Blue, S.C.; Odom, T.R.; Stitt, D.H. (Paducah Gaseous Diffusion Plant, KY (USA)). 26 Feb 1979. Contract W-7405-ENG-26. 51p. NTIS, PC A04/MF A01.

Sudden unpredicted changes in the operating plan of the Gaseous Diffusion Plants precipitated a requirement for additional 14-ton cylinders for shipment of nonenriched UF_6. The large quantity of A-516 steel normally specified for these cylinders was unavailable in the required time so ASTM A-285 Grade C was specified for the shell. This report provides documentation of tests and evaluations done to assure compliance of the cylinder fabricated from the new material to 10 CFR 71.

TRANSPORT AND STORAGE FACILITIES

38535 (ORNL/TM—7390) **Screening study on high temperature energy transport systems.** Graves, R.L. (Oak Ridge National Lab., TN (USA)). Oct 1980. Contract W-7405-ENG-26. 49p. NTIS, PC A03/MF A01.

The purpose of the study described in this document is to identify the options for transporting thermal energy over long distances. The study deals specifically and exclusively with high temperature [> 400°C(752°F)] energy for industrial use. Energy transport is seen as a potential solution to: high unit cost of small coal and nuclear steam generators, and opposition to siting of coal or nuclear plants near populated areas. The study is of a preliminary nature but covers many options including steam, molten salts, organics, and chemical heat pipes. The development status and potential problems of these and other energy transport methods are discussed. Energy transport concepts are compared on a fundamental level based on physical properties and also are subjected to an economic study. The economic study indicated that the chemical heat pipe, under a specific set of circumstances, appeared to be the least expensive for distances greater than about 32 km (20 miles). However, if the temperature of the energy was lowered, the heat transfer salt (sodium nitrate/nitrite) system would apparently be a better economic choice for less than about 80 km (50 miles). None of the options studied appear to be more attractive than small coal-fired boilers when the transport distance is over about 64 km (40 miles). Several recommendations are made for refining the analysis.

MINING AND DRILLING EQUIPMENT AND FACILITIES

REFER ALSO TO CITATION(S) 37574

LASERS

38536 (KMSF-U—944) **Chemically pumped iodine laser as a fusion driver.** Busch, G.E. (KMS Fusion, Inc., Ann Arbor, MI

(USA)). 1980. Contract AC08-78DP40030. 4p. (CONF-800208—19). NTIS, PC A02/MF A01.

From Topical meeting on inertial confinement fusion; San Diego, CA, USA (26 Feb 1980).

The recently demonstrated chemically pumped iodine laser is evaluated for fusion requirements. Efficiencies greater than 8% and long energy storage times are predicted, with high repetition rates and elimination of pulsed power supplies.

38537 Small signal gain of free electron lasers with nonuniform wigglers. Brau, C.A. (Los Alamos Sci Lab, NM). *IEEE J. Quant. Electron.;* **QE-16**: No. 3, 335-339(Mar 1980).

The small-signal gain of free electron lasers is calculated by solving the single-electron equations of motion to second order in the laser field. Analytic results for free electron lasers with linearly varying wiggler resonant frequency show that the small signal gain of such lasers behaves differently from that of lasers with uniform wiggler resonant frequency and is significantly smaller. 6 refs.

38538 Injection-locked unstable resonator rare gas halide discharge laser of narrow linewidth and high spatial quality. Goldhar, J.; Rapoport, W.R.; Murray, J.R. (Lawrence Livermore Lab, Calif). *IEEE J. Quant. Electron.;* **QE-16**: No. 2, 235-241(Feb 1980).

An oscillator-amplifier KrF discharge laser system capable of providing up to 400 mJ output with 0.1-cm/sup -1/ linewidth in a 20-ns pulse is described. The output beam divergence is described and shown to be affected by the discharge current. The output beam is near the diffraction limit in the direction parallel to the discharge and about three times the diffraction limit transverse to the discharge. Operation with XeCl at up to 250 mJ with similar linewidth and spatial quality is also described.

38539 Reliable thyratron-switched flashlamp-pumped dye laser. Chu, S. (Univ. of California, Berkeley); Smith, R.W. *Opt. Commun.;* **28**: No. 2, 221-226(Feb 1979).

A thyratron-switched flashlamp-pumped dye laser capable of an average power of approximately 1 watt operating at 40 pulses/sec with a bandwidth of several GHz is described. The lamps are run in a high-current simmering mode to decrease lamp inductance and extend lamp life. In heavy use the laser system has proven to be very reliable with lamp lifetimes in excess of 10^7 shots and half-power dye lifetimes of better than 10^6 J/l for Rhodamine 6G.

38540 Chemical pumping of the far infrared HCN laser. Robinson, D.W. (Johns Hopkins Univ., Baltimore, MD). Contract EY-76-S-02-2523. *Opt. Commun.;* **27**: No. 2, 281-286(Nov 1978).

The observation is reported of 337 μm and 311 μm stimulated emission from HCN in which the (11^10)-(04^00) inversion has been established by photopumping of HCN and by chemical pumping with reactions between CN and H_2 or saturated hydrogen-rich organic compounds. Similarities in output pulse behavior between the discharge and chemical versions of the HCN laser are suggestive that the pumping mechanism in the discharge is the chemical reaction, $CN + H_2 \rightarrow HCN + H$. The well-known inefficiency of this laser is then due to the fact that the reaction is a slow one and its exothermicity does not match the energy of the upper lasing level, but depends for inversion on (randomizing) relaxation into (11^10) among others. Substantial improvements in the power of the HCN laser cannot be made from this route.

HEAT TRANSFER AND FLUID FLOW

38541 (ANL/MSD/FE—80-4) Development of nondestructive evaluation techniques for high-temperature ceramic heat exchanger components. Eleventh quarterly report, April-June 1980. (Argonne National Lab., IL (USA)). Aug 1980. Contract W-31-109-ENG-38. 35p. NTIS, PC A03/MF A01.

One of the problems associated with ultrasonic inspection of silicon carbide tubes from the bore side, for wall-thickness measurements or detection of laminar flaws, is the mode conversion of nominally normal-incidence longitudinal waves to shear waves. Under the right circumstances the shear wave can be detected by the transducer after it converts back to a longitudinal wave, and can be confused with a legitimate flaw signal. This phenomenon occurs because of the sharp curvature of the tube and the width of the ultrasonic beam. The effect is discussed in some detail in the present report; reducing the width of the ultrasonic beam to $\sim$ 1 mm is shown to virtually eliminate the problem while not reducing the signal amplitude of the backwall echoes significantly (i.e., by $>$ 5 dB). Infrared techniques have been applied to inspection of glass-adhesive overlap joints in silicon carbide tubes. The results suggest that infrared techniques may be employed successfully in characterizing ceramic overlap joints through observation of heat-flow patterns. Results of previous efforts had led to the conclusion that holographic interferometry, although sensitive to surface flaws, would be difficult to use as a general inspection method for ceramic materials. This technique needs to be reassessed with respect to ceramic joints for two reasons. One is that the irregular geometry of many joints makes ultrasonic signal interpretation difficult, but leaves open the possibility of detecting flaws indirectly by looking for regions of high strain. The other reason for a new look at holography is that the introduction of a television camera and videotape system has made the production and evaluation of holographic interferograms much easier.

38542 (DOE/BC/10025—18) Evaluation of orifice meter recorder measurement errors in lower & upper capacity ranges. Final report. Schmidt, Z.; Brill, J.P.; Beggs, H.D.; Coberly, W.A.; Fujita, J. (Tulsa Univ., OK (USA); Department of Energy, Bartlesville, OK (USA). Bartlesville Energy Technology Center). Sep 1980. Contract AC19-79BC10025. 79p. NTIS, PC A05/MF A01.

Objectives were to determine and analyze the magnitude of errors in gas flow rate measurements that occurred from operating orifice meters beyond the restricted range of pressure loss. Measurement errors are attributed to mechanical inaccuracies in recorders. Standard two-pen recorders require some mechanical action to record pressure loss across orifice plates. This mechanical action probably causes the response to be nonlinear over the lower and upper range of the recorder specifications. No current or past research has been found that documents or analyzes these inaccuracies. The magnitude of errors in gas flow rate measurements that occurs from operating orifice meters in the upper and lower limits of their ranges was studied experimentally. A total of 303 sets of data was obtained. The data included both the differential pressure and static pressure measurements of four different orifice recorders, plus the flowing temperature and the static pressure of a sonic nozzle. The volumetric flow rates calculated from the data recorded in the upper and lower ranges were compared to flow rates calculated from data in the middle range. Results show that accurate gas flow rate measurements can be obtained by restricting the operating range of the meter to between 20 and 100% of the maximum.

38543 (EGG/ENI—143) Heat transfer modeling for a non-fluidized particulate bed. Pryatel, J.A. (Exxon Nuclear Idaho Co., Inc., Idaho Falls (USA)). Sep 1980. Contract AC07-79ID01675. 45p. NTIS, PC A03/MF A01.

A non-fluidized particulate bed was studied by adapting state-of-the-art computer codes to traditional mathematical models. The bed consisted of uranium dioxide bearing solids which generate decay heat and are immersed in a water based liquid. The ultimate problem was to determine the possibility of realizing fluid vaporization within the bed due to internal heat generation. Heat transfer through the bed was simulated through mathematically modeling particle to particle and particle to void to particle conduction, followed by fine tuning through empirical data supplied by others. The mathematical model and boundary conditions were entered into EG and G Idaho's computer codes INGEN/MOD1 and TRIPLE/MOD1 to obtain bed temperature profiles. A subroutine of TRIPLE/MOD1 was adapted to account for heat of transition energies. The data showed the bed to be conduction sensitive (i.e., changes in conductivity had a disproportionate effect on the temperature compared to effects of changes in boundary conditions). And, as might be expected, phase change energies dominated heat capacity effects in resisting boiling. In the case studies, significant periods lapsed before boiling could be seen in the bed, a result which could be capitalized on during process operation.

38544 (SAND—80-1276) Well-posedness of the two-phase flow problem. Part 2. Stability analyses and microstructural models. Hicks, D.L. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1980. Contract AC04-76DP00789. 35p. NTIS, PC A03/MF A01.

In Part 1 the Routh-Hurwitz criterion was used to analyze the roots of stability polynomials associated with a microstructural model for two-phase flow. In Part 2 (this report) the k-expansion procedure is seen to require much less algebra than the Routh-Hurwitz procedure. The k-expansion procedure is used herein to analyze the stability in the sense of von Neumann of certain microstructural models for two-phase flow. Several of these models are unstable. However, these models may be stabilized by the inclusion of viscous stresses.

38545 (UCRL—83673) High resolution difference schemes for compressible gas dynamics. Woodward, P.; Colella, P. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 30 Jul 1980. Contract W-7405-ENG-48. 9p. (CONF-800661—3). NTIS, PC A02/MF A01.

From 7. international conference on numerical methods in fluid dynamics; Palo Alto, CA, USA (23 Jun 1980).

The advantages and disadvantages of four new high-resolution difference schemes, namely the von Neumann-Richtmyer, Godunovs, MUSCL and Glimms, for mathematically representing physical conditions in compressible gas flows are compared. (LCL)

38546 Knudsen flow through multiple barriers. Meschi, D.J.; Basu, T.K.; Searcy, A.W. (Univ. of California, Berkeley). *High Temp. Sci.;* **9**: 263-273(1977).

The flux density of sodium chloride vapor which escapes through a circular orifice in a plate that fits flush against the exit face of a porous alumina barrier is shown to decrease by a factor of 100 when the orifice diameter is increased from 0.04 to 1.0 cm. A model which treats the porous disk and the orifice as two barriers separated by a chamber that has no significant radial-flux density gradient gives qualitative agreement with the experimental variation of flux density with orifice diameter and is of sufficient generality to yield the Whitman-Motzfeld equation for effusion cells as a special case. A model which assumes that a radial-flux density gradient exists in a 20 μm high chamber between the porous barrier and the disk gives quantitative agreement with the experiments.

MATERIALS TESTING

REFER ALSO TO CITATION(S) 37574

38547 (BDX—613-2482) **Experimental modeling of laminar composites for multifrequency eddy current measurements.** Heckman, R.V. (Bendix Corp., Kansas City, MO (USA)). Aug 1980. Contract AC04-76DP00613. 45p. NTIS, PC A03/MF A01.

Portions of document are illegible.

This report describes a computer modeling program, originally developed by Dodd and Deeds of Oak Ridge National Laboratory, capable of calculating the experimental voltage amplitudes and phases which can be obtained with rectangular cross-section coils being operated at multiple frequencies. This program was applied to two multilayered composites in order to determine the feasibility of making thickness and resistivity measurements of the individual layers. The results of these calculations indicate that the thickness of the aluminum/Kapton composite layers could be measured to a precision of better than 1% and the resistivity of the conductive layers could be measured to a precision of better than 10%. The second composite, a structure consisting of alternating layers of aluminum and polyimide, a varnish, was found to be measureable also. A minimum of two frequency components were found to be necessary for the aluminum/Kapton composite while three frequencies were found to be necessary for the aluminum polyimide case.

38548 **Detection of free liquid in drums of radioactive waste.** (to Dept. of Energy). US Patent Application 085,370. 16 Oct 1979. 20p.

A nondestructive thermal imaging method for detecting the presence of a liquid such as water within a sealed container is described. The process includes application of a low amplitude heat pulse to an exterior surface area of the container, terminating the heat input and quickly mapping the resulting surface temperatures. The various mapped temperature values can be compared with those known to be normal for the container material and substances in contact. The mapped temperature values show up in different shades of light or darkness that denote different physical substances. The different substances can be determined by direct observation or by comparison with known standards. The method is particularly applicable to the detection of liquids above solidified radioactive wastes stored in sealed containers.

VACUUM ENGINEERING

38549 **Influence of virtual leaks on the pressure in high and ultra-high vacuum systems.** Edwards, D. Jr. (Brookhaven National Lab., Upton, NY). *Vacuum;* **29**: No. 4/5, 169-172(1979).

It is found that the least upper bound to the pressure in a vacuum system wth a virtual leak is $Q_0/(et_0S)$. Where Q_0 (torr.l) is the quantity of gas trapped at $t = 0$, $e = 2.718$, $t_0(s)$ is the time from the start of the pumpdown and S (l/s) is the real pumping speed.

ELECTRONIC CIRCUITS AND DEVICES

REFER ALSO TO CITATION(S) 38611

38550 (SAND—80-0957C) **Surprising patterns of CMOS susceptibility to ESD and implications on long-term reliability.** Schwank, J.R.; Baker, R.P.; Armendariz, M.G. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 8p. (CONF-800962—1). NTIS, PC A02/MF A01.

From Electrical overstress/electrostatis discharge symposium; San Diego, CA, USA (9 Sep 1980).

CMOS electrostatic discharge (ESD) failures in a product where, by design, the device input terminals are not accessible to ESD led to this study of device susceptibility and an analysis of the long-term reliability of devices in assemblies from that production line. Some surprising patterns of device susceptibility are established and it is shown that the probability of long-term failure in devices whose electrical characteristics have been degraded by electrostatic discharge is small.

38551 (SAND—80-1772) **HOST33-PREP3D programmer/user guide.** Malloch, J.E. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1980. Contract AC04-76DP00789. 23p. NTIS, PC A02/MF A01.

This document describes program HOST33-PREP3D, which maps a subset of an APPLE-formatted Applicon AGS/884 PWB drawing file into an APPLE-formatted Applicon AGS/874 drawing file, which may be further processed to produce a GERBER plot of the printed wiring board.

38552 (UCID—18741) **DASLL: design automation system at Lawrence Livermore. User's reference manual.** Magnuson, W.G. Jr.; Willett, G.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Apr 1980. Contract W-7405-ENG-48. 142p. NTIS, PC A07/MF A01.

This manual shows how to use the DASLL system to lay out printed circuit boards using the OCTOPUS CDC 7600 computer system and other equipment at Lawrence Livermore Laboratory. This information will also be found very useful for those converting or analyzing the DASLL system.

38553 **Brightness of LaB_6 cathodes.** Noack, M.A.; Gibson, E.D.; Verhoeven, J.D. (Ames Laboratory and Department of Materials Science and Engineering, Iowa State University, Ames, Iowa 50011). *J. Appl. Phys.;* **51**: No. 10, 5566-5567(Oct 1980).

Single-crystal LaB_6 cathodes were prepared by arc float zone refining and their stoichiomerty and impurity level have been determined. The brightnesses of cathodes were evaluated in a SEM modified to allow in situ measurement of the cathode tip temperature. Three crystallographic orientations were evaluated and the relative brightness was found to follow the order (100)>(321)>(110) with the value for the (100) orientation being around 10^6 A/cm^2 sr at 1900 °K.

WASTE PROCESSING PLANTS AND EQUIPMENT

REFER ALSO TO CITATION(S) 38313, 38315, 38316

COMBUSTION SYSTEMS

REFER ALSO TO CITATION(S) 37512, 37537, 37539, 37540, 37541, 38076, 38078, 38323, 38324, 38373, 38374, 38376

38554 (CONF-800428—(Vol.1), pp 18-22) **Fluidized bed combustion: a status check.** Byam, J.W. (Department of Energy, Morgantown, WV). Aug 1980.

From 6. international conference on fluidized bed combustion; Atlanta, GA, USA (9 Apr 1980).

The primary advantage of fluidized-bed combustion is the reduction of SO_2 emissions during the combustion process. There is also a reduction in NO/sub x/ emissions and the capability to burn a very wide range of fuels. Other advantages include a modest reduction in cost for the capital, equipment, and operations of a fluidized-bed plant versus a conventional steam plant; the fact that fluidized-bed technology can be used to burn the high ash western coals and lignites as well as anthracites and high sulfur bituminous coals of the east; and the fact that FBC technology can burn low-grade combustibles, not only coals, but industrial waste. DOE has therefore established a program to address these various objectives and our program goals are shown in figure 1.

38555 (CONF-800428—(Vol.1), pp 23-29) **Overview of the progress in fluid bed combustion in the United Kingdom.** Willis, D.M. (National Coal Board, Stoke Orchard, England). Aug 1980.

From 6. international conference on fluidized bed combustion; Atlanta, GA, USA (9 Apr 1980).

38556 (CONF-800428—(Vol.1), pp 30-35) **Overview of the fluidized bed combustion programme of the Federal Republic of Germany.** Holighaus R.; Batsch, J. (Kernforschungsanlage Juelich G.m.b.H, Germany). Aug 1980.

From 6. international conference on fluidized bed combustion; Atlanta, GA, USA (9 Apr 1980).

Some basic advantages of FBC are: the furnace temperature is kept low and uniform; consequently, NO/sub x/ formation is low; because SO_2-emission can be reduced by the addition of limestone or dolomite, an expensive and efficiency consuming flue gas desulfurization plant is not required; heat transfer coefficients are high. This means, that the heat-exchanger areas and consequently the boilers can be smaller than in pulverized fuel firing; and low grade fuels can be used. Pressurized fluidized bed combustion (PFBC) offers special

advantages with respect to environmental protection, combustion efficiency, geometric size, and, if combined with a gas turbine, to the thermal efficiency of the total plant. Serious development problems have to be overcome in the case of PFBC. Therefore, atmospheric fluidized bed combustion (AFBC) was incorporated in our FBC research program because it can be developed for commercial application within a considerably shorter time than PFBC. In addition a relatively simple concept is favorable for small plants, such as industrial boilers and small power station units, where a complex technology leads to comparatively high investment costs.

38557 (CONF-800428—(Vol.1), pp 36-40) **Progress of fluidized-bed boilers in People's Republic of China.** Zhang, X.Y. (Tsinghua Univ., Beijing, People's Republic of China). Aug 1980.

From 6. international conference on fluidized bed combustion; Atlanta, GA, USA (9 Apr 1980).

Early in the 1960's, based on the broad adoption of successful fluidized-bed calcination technology, China began its research work on fluidized-bed combustion boilers. Presently, there are over 2000 fluidized-bed combustion (FBC) boilers in China. Many boilers have capacities of 4 to 10 T/h and are used for generating saturated steam, while others with capacities of 10 to 50 T/h are used for power generation and industrial applications. FBC boilers with capacities of 130 T/h are now being tested. The fuels used in China for most FBC boilers are low-grade fuels such as shale fines, low-grade bituminous coal and anthracite, coal washery waste, stone-like coal, lignite, etc. The heating value of the fuels now being used, ranges from 1000 to 1500 Kcal/kg. The boilers are being used either for industrial purposes or for generating electricity. Many boilers possess more than 40,000 hours of accumulated operational experience. In China, there are a number of organizations taking part in the research and development of fluidized-bed combustion-fired boilers. Many technical institutes such as Tsinghua University, Zhejiang University, Harbin Technical Institute, etc., are the major institutions conducting research work. Shanghai Boiler Works, Dungfang Boiler Works, and Kuangchow Boiler Works, etc., are the chief FBC boiler designers and manufacturers. Extensive research work has been done on the fluidized bed operating parameters selection, combustion of low-heating value fuels, improvement of thermal efficiency, desulfurization with limestone, and boiler structures.

38558 (CONF-800428—(Vol.1), pp 41-44) **TVA's AFBC projects.** High, M.D. (Tennessee Valley Authority, Chattanooga). Aug 1980.

From 6. international conference on fluidized bed combustion; Atlanta, GA, USA (9 Apr 1980).

The concept of a fluidized bed has been employed extensively in the petrochemical industry for many years. However, the concept of using AFBC for large-scale utility use is relatively new. The major thrust of AFBC development for utility use to date has been in bench-scale studies, research, and hot/cold AFBC modeling. This research has resulted in a degree of progress. The 30-MW Rivesville AFBC unit, for example, demonstrated that AFBC could generate electricity. Since Rivesville was a converted steam plant, however, it did not have the capability of experimenting and testing new AFBC designs as they became available. Nor did the Rivesville AFBC unit provide much in the way of data collection on its operation. TVA's 20-MW AFBC pilot plant will address uncertainties concerning peripheral hardware systems and plant operation. By late 1981, TVA will have a 20-MW AFBC pilot plant and is considering constructing a 200-MW AFBC demonstration plant that would commence operation in late 1985. These two plants would be the culmination of research and development that dates back to 1974 when TVA first became interested in AFBC development. Furthermore, AFBC appeared to be a cost effective way to both use the high sulfur coal (of which the Tennessee Valley region has tremendous reserves) and to protect the environment.

38559 (CONF-800428—(Vol.1), pp 46-49) **Fluidized bed combustion: an evolutionary improvement in electric power generation.** Yeager, K.E. (Electric Power Research Inst., Palo Alto, CA). Aug 1980.

From 6. international conference on fluidized bed combustion; Atlanta, GA, USA (9 Apr 1980).

Fluid bed combustion offers promise of providing a substantial but evolutionary improvement in the utilization of coal for electric power production. Flexibility to burn alternative fuels with minimum performance and reliability penalty has been established. The stringent emission standards existing and proposed in the United States should be met without complicated and parasitic post-combustion cleanup devices. These significant improvement opportunities have fostered major utility industry development efforts for both AFBC and PFBC. In the final analysis, however, the utility market potential of these technologies will depend primarily on demonstration of power plant reliability and availability advantages over the alternatives. As we move forward we must remember that these alternatives are also undergoing vigorous development in the horse-race for the coal-fired power plant market of the 1990's and beyond.

38560 (CONF-800428—(Vol.1), pp 50-62) **Conclusions of the EPA fluidized-bed combustion program.** Henschel, D.B. (Environmental Protection Agency, Research Triangle Park, NC). Aug 1980.

From 6. international conference on fluidized bed combustion; Atlanta, GA, USA (9 Apr 1980).

The purpose of this paper is to smmarize the current conclusions of the US Environmental Protection Agency's Industrial Environmental Research Laboratory, Research Triangle Park, NC, concerning the ability of atmospheric and pressurized fluidized-bed combustion systems to meet currently identified environmental requirements. In summary, based upon available data, it is anticipated that both atmospheric and pressurized systems should be capable of meeting the recently revised New Source Performance Standards (NSPS) covering air emissions of sulfur dioxide (SO_2), nitrogen oxides (NO/sub x/), and particulates from electric utility steam-generating units. NSPS for industrial boilers have not yet been proposed by EPA; however, fluidized-bed boilers should be able to meet the industrial boiler standards as well, if these standards are not significantly more stringent, or are less stringent, than the standards covering utility steam generators. The EPA standards should be achieved in fluidized-bed combustion systems in a manner which is economically competitive with a conventional boiler with flue gas desulfurization; the greatest economic uncertainty concerns the control of particulates at elevated temperatures and pressures in pressurized combustors. Additional data from large fluidized-bed combustors, representative of commercial-scale systems, are necessary to confirm these conclusions. Solid residues from atmospheric and pressurized fluidized-bed combustors, in general, should not be considered as hazardous wastes under the Resource Conservation and Recovery Act (RCRA), based upon RCRA procedures as currently defined. However, the properties of leachate from the residue will necessitate some attention in the design of a sanitary landfill for disposal of the residues as non-hazardous wastes.

38561 (CONF-800428—(Vol.1), pp 64-83) **Plenary session 2. Fluidized bed combustion development and commercial status summary.** Freedman, S.I. (Department of Energy, Washington, DC). Aug 1980.

From 6. international conference on fluidized bed combustion; Atlanta, GA, USA (9 Apr 1980).

Panel discussions after the technical papers contain several interesting viewpoints by people from different companies and countries on the status, economics and current plans for research and commercialization. (LTN)

38562 **Low NO/sub x/ heavy fuel combustor program.** Lister, E.; Niedzwiecki, R.W.; Nichols, L. (NASA, Lewis Res Cent, Cleveland, Ohio). *Am. Soc. Mech. Eng., [Pap.]*: No. 80-GT-69, vp(1980).

The "Low NOx Heavy Fuel Combustor Program" is a part of the DOE/LeRC "Advanced Conversion Technology Project" (ACT). The program is a multiple contract effort with funding provided by the Department of Energy, and technical program management provided by NASA LeRC. Main program objectives are to generate and demonstrate the technology required to develop durable gas turbine combustors for utility and industrial applications, which are capable of sustained, environmentally acceptable operation with minimally processed petroleum residual fuels.

38563 (FE—2357-35) **PFB Coal Fired Combined Cycle Development Program: turbine materials evaluation, March 1980.** (General Electric Co., Schenectady, NY (USA). Energy Systems Programs Dept.). Mar 1980. Contract EX-76-C-01-2357. 163p. NTIS, PC A08/MF A01.

This report presents the results of cladding technology development under the Coal-Fired Combined Cycle DOE Project for the period July 1976 through June 1978. Sub-task 3.1, Clad Alloy Development, involved the selection, fabrication and burner rig evaluation of advanced clad alloy compositions diffusion-bonded to IN-738. Testing was conducted for up to 5800 hours at 1600°F in a simulated PFB environment. Metallographic evaluation showed Co-base cladding alloys PFB-5PM and PFB-6PM (aluminided) and Fe-base alloy GE-2541 to be the most corrosion resistant. The formability and fabricability of sheet material was significantly improved for these alloys by utilizing powder metallurgy techniques. Sub-task 3.2, Clad Process Development, encompassed processing activities to evaluate sheet alloy formability, bucket surface preparation techniques, platform clad forming, and the activated diffusion bonding (ADB) of corrosion resistant tips to MS5001 buckets. The main focus of this sub-task, however, involved comprehensive evaluation of clad composite mechanical properties. The results of tensile, creep-rupture, high cycle fatigue, thermal fatigue, bend and unnotched impact tests over the temperature range 70 to 1600°F are presented for IN-738 clad with GE-2541, IN-671, PFB-5PM and aluminided S-57 and PFB-6PM. The effect of preexposure at 1700°F for 1000 hours was also investigated.

38564 (FE—2452-33) **Hot corrosion/erosion testing of materials for application to advanced power conversion systems using coal-derived fuels. Task II: fluidized bed combustion. Third task report,**

July 1-September 30, 1978. Nutkis, M.S.; Bertrand, R.R.; Ernst, M.; Hoke, R.C.; Loughnane, M.D.; Siminski, V.J. (Exxon Research and Engineering Co., Linden, NJ (USA). Government Research Labs.). Jan 1979. Contract EX-76-C-01-2452. 95p. NTIS, PC A05/MF A01.

The second and third segments of a 1000 hour exposure test of potential gas turbine and boiler tube materials for use in Pressurized Fluidized Bed Coal Combustion were successfully completed. This brought the total exposure time to 565 hours on the gas turbine specimens and 682 hours on the heat exchanger specimens. The 100 hour test (Run 79) had to be terminated prematurely because of a plug in the solids discharge line from the first (recycle) cyclone. The 215 hour test (Run 80) was interrupted at the 82 hour mark to replace a leaking valve. After the interruption, the turbine flow rate dropped 12% as a result of a blockage at the turbine inlet. The lower level flow, still within specifications, was maintained for the duration of the run. Measurements of the particulate loading entering the gas turbine during Run 79 indicated a rise in loading from a level of 0.01 gr/SCF at the beginning to 0.03 gr/SCF near the end of the test. This increase was presumably a consequence of the first cyclone dipleg plugging. The particulate had a mass median size of 1.5 microns with little variation from the beginning to the end of the test. During Run 80 particulate measurements taken before and after the turbine were low and consistent, averaging about 0.02 gr/SCF. The particulates had a mass median size of 1.2 microns. The gas turbine specimens showed no visible signs of attack after 565 hours. There was, however, substantial flyash deposition, similar to the deposits found after the first 250 hour test. All the heat exchanger probe specimens looked satisfactory except for an Inconel 800/Hastelloy X probe controlled at 1400°F. There was considerable wastage and a small rupture near the capped end. A piece was removed for analysis and the probe repaired for future tests.

38565 (FE—2452-39) **Hot corrosion/erosion testing of materials for application to advanced power conversion systems using coal-derived fuels. Task II: fluidized bed combustion. Final report, July 1, 1976-September 30, 1979.** Nutkis, M.S.; Loughnane, M.D.; Ernst, M.; Bertrand, R.R.; Matulevicius, E.S. (Exxon Research and Engineering Co., Linden, NJ (USA)). Nov 1979. Contract AC01-76ET10541. 160p. NTIS, PC A08/MF A01.

The objective of this program was to provide an experimental basis for specifying materials for heat exchangers and gas turbines exposed to a pressurized fluidized bed combustor environment. A 1000 hour test was completed which: (1) exposed heat exchanger materials both within the fluidized bed and in the freeboard of a pressurized fluidized bed combustor at temperatures ranging from 1050 to 1600°F for up to 1117 hours; and (2) provided the first successful long term exposure of turbine blade materials subjected to PFBC flue gas where the particulates were removed solely by cyclones. This report describes the operating conditions and major observations during this test period. Operating conditions varied sufficiently to significantly alter the particulate loading and mean particle diameter of the particulate entering the turbine section. This permitted several observations to be made: most of the turbine blade specimens appeared to be in satisfactory condition showing little, if any, erosion; particulate loading and/or particle size had a profound effect on the degree of deposition and erosion on the turbine blades; and in general, erosion was not visually apparent when 3 stages of conventional cyclones were used to clean the PFBC flue gas (however, upsets could cause marked erosion if the grain loading and particulate size increased only by small amounts). The heat exchanger specimens appeared to be in satisfactory condition both in bed and above the fluidized bed. These tests indicated the possibility that conventional cyclones alone may be sufficient to protect gas turbine blade materials exposed to PFBC flue gas. Also, there seems to be satisfactory heat exchanger materials for above-bed use and probably in-bed use.

POLLUTION CONTROL EQUIPMENT

REFER ALSO TO CITATION(S) 38091, 38654

38566 (PB—80-126022) **Standard support and environmental impact statement. volume II: promulgated standards of performance for stationary gas turbines.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Emission Standards and Engineering Div.). Sep 1979. 64p. NTIS, PC A04/MF A01.

Standards of performance to control nitrogen oxides and sulfur dioxide emissions from new, modified, and reconstructed stationary gas turbines in the U.S. are being promulgated under section III of the Clean Air Act. This document contains information on the public comments made after proposal, EPA responses and differences between the proposed and promulgated standards.

38567 (PB—80-135239) **Applicability of transmissometers to opacity measurement of emissions, oil-fired power and portland cement plants. Final report, Apr 1976-Oct 1977.** Conner, W.D.; Knapp, K.T.; Nadar, J.S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab.). Sep 1979. 59p. NTIS, PC A04/MF A01.

In-stack transmissometers were evaluated for their capability to monitor the opacity of smoke-stack plumes emitted by certain sources. In-stack transmissometers were installed on three portland cement plants and three oil-fired power plants. Tests were conducted to determine their performance in four areas: the adequacy of the U.S. Environmental Protection Agency-promulgated transmissometer design and performance specifications for the sources, the correlation between the opacity of the emissions measured in the plumes and in the stacks of the sources, as well as the existence of a functional relationship between the transmissometer-measured opacity and mass concentration of the particulate emission.

38568 (PB—80-140510) **Control techniques for carbon monoxide emissions. Final report.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Jun 1979. 410p. NTIS, PC A18/MF A01.

This document characterizes carbon monoxide emission sources and controls for use by states in revising State Implementation Plans. It is intended for use by state and local air pollution control engineers to provide basic available informaton on carbon monoxide emissions from mobile sources, stationary combustion sources, and industrial process sources. Both demonstrated and feasible control strategies are presented for each source. Information is also provided on emission reduction benefits, energy requirements of controls, and annualized and operating costs of controls.

RANKINE

REFER ALSO TO CITATION(S) 38264

STIRLING

REFER ALSO TO CITATION(S) 38264

PARTICLE ACCELERATORS

PARTICLE ACCELERATORS

DESIGN, DEVELOPMENT, AND OPERATION

REFER ALSO TO CITATION(S) 39010, 39168, 39169, 39171, 39173

38569 (DOE/ER—0067) **Report of the Subpanel on Accelerator Research and Development of the High Energy Physics Advisory Panel.** (Department of Energy, Washington, DC (USA). Div. of High Energy Physics). Jun 1980. 106p. NTIS, PC A06/MF A01.

Accelerator R and D in the US High Energy Physics (HEP) program is reviewed. As a result of this study, some shift in priority, particularly as regards long-range accelerator R and D, is suggested to best serve the future needs of the US HEP program. Some specific new directions for the US R and D effort are set forth. 18 figures, 5 tables. (RWR)

38570 (LBL—10301) **Proceedings of the heavy ion fusion workshop.** Herrmannsfeldt, W.B. (ed.). (California Univ., Berkeley (USA). Lawrence Berkeley Lab.; Stanford Linear Accelerator Center, CA (USA)). Sep 1980. Contract W-7405-ENG-48;AC03-76SF00515. 526p. (CONF-7910122—; SLAC-PUB—2575). NTIS, PC A23/MF A01.

From Heavy ion fusion workshop; Berkeley, CA, USA (29 Oct 1979).

Separate abstracts were prepared for 35 of the included papers. Abstracts for 9 of the remaining papers appeared earlier in ERA. Two of the included papers were title listed only. (MOW)

38571 (LBL—10301, pp 68-76) **Computer design of a high current, high energy proton linac.** Foss, M.H. (Argonne National Lab., IL). Sep 1980.

From Heavy ion fusion workshop; Berkeley, CA, USA (29 Oct 1979).

The accelerator produces enough beam to make the same number of neutrons on the average as 0.5 mA of 800 MeV protons. The beam is delivered to the target in 200 ns pulses at 50 Hz. The results are presented here because some of the problems are similar to HIF problems. In the Linac discussed here, the current at each point is constant throughout the pulse. A constant current is extracted from the ion source for a time dT = 2. This beam passes an

accelerating gap at D = 0. The velocity profile is adjusted so that the beam is bunched. The time required for the beam to pass a point decreases linearly from dT = 2 to dT = 0 as the distance goes from D = 0 to D = 4.

38572 (LBL—10301, pp 151-156) **Investigation of tolerances for the parameters of the proposed LBL Test-Bed linear induction accelerator.** Chattopadhyay, S.; Faltens, A.; Laslett, L.J.; Smith, L. (Lawrence Berkeley Lab., CA). Sep 1980.

From Heavy ion fusion workshop; Berkeley, CA, USA (29 Oct 1979).

The Lawrence Berkeley Laboratory has proposed the construction of a Test-Bed linear induction accelerator to test the technique of accelerating heavy ions by use of induction modules and to investigate the transverse focusing of the ion beam by a FODO sequence of magnetic quadrupole lenses. The induction accelerator is intended to accept a 6-μsec bunch of Cs^{+1} ions with 3-MeV kinetic energy ($\beta_0 \simeq 0.007$) from a sequence of a few pulsed drift tubes and to accelerate these ions to a kinetic energy of approximately 25 MeV ($\beta \simeq 0.020$) in a distance $\simeq 10^2$ meter. The approximately 3-fold increase of velocity, combined with bunching of the beam by a factor of two, would result in a six-fold increase of current. A favorable value of transverse emittance - e.g., $\pi\epsilon N = (2.5 \times 10^{-8})\pi$ meter radian, normalized - then could be expected to permit a beam current that increases from $I_0 = 2.5$ A ($\simeq 15$ μC) to I $\simeq 15$ A to be accommodated within an acceptable aperture.

38573 (LBL—10301, pp 157-181) **Ion induction linacs: reference design and proposed test-bed.** Faltens, A.; Keefe, D. (Lawrence Berkeley Lab., CA). Sep 1980.

From Heavy ion fusion workshop; Berkeley, CA, USA (29 Oct 1979).

The LBL HIF program has concentrated on the induction linac approach because this type of machine is able to accelerate the entire charge required for fusion in a single, high current bunch, and because of our experience ten years ago using the Astron induction linac at LLL and subsequently building and operating our own machine at LBL. The operation of an rf linac with storage rings is based on an operating line where, excluding the tree of linacs at the lowest energies, acceleration is along a constant current trajectory to peak energy, and then along a constant energy trajectory as the current is compressed and multiplied to reach the required of beam power (> 100 TW). The operation of the linear induction accelerator is along a trajectory where the energy and current are increased simultaneously; at the end of acceleration the beam is split transversely into two groups of beams to provide for higher peak power and a left-right symmetrical pellet bombardment.

38574 (LBL—10301, pp 305-309) **Design study of an accelerator for heavy ion fusion.** Katayama, T.; Noda, A.; Tokuda, N.; Hirao, Y. (Univ. of Tokyo, Japan). Sep 1980.

From Heavy ion fusion workshop; Berkeley, CA, USA (29 Oct 1979).

Design of a demonstration accelerator for heavy ion fusion based on a synchrotron system is briefly described. The proposed complex system of injector linac, rapid cycling synchrotron and five accumulation rings can produce a peak current 1.6 kA, peak power 32 TW and total energy 0.3 MJ. Investigations of the intrabeam scattering give a lifetime of the beam longer than the fusion cycle time of 1 sec.

38575 (LBL—10301, pp 334-352) **NUMATRON and TARN.** Katayama, T.; Noda, A.; Hirao, Y. (Univ. of Tokyo, Japan). Sep 1980.

From Heavy ion fusion workshop; Berkeley, CA, USA (29 Oct 1979).

General descriptions of the NUMATRON design and related technical developments at INS, University of Tokyo, are reported. A test accumulation ring for the NUMATRON project, TARN, was constructed for integrating various technical developments. Recent results of the injection test using this ring are also described.

38576 (LBL—10301, pp 377) **Final transport in vacuum: summary.** Brown, K. (Stanford Linear Accelerator Center, CA); Colton, E.; Fenster, S.; Garren, A.; Haber, I.; Hofmann, I.; Lawson, J.; Penner, S.; Peterson, J. Sep 1980.

From Heavy ion fusion workshop; Berkeley, CA, USA (29 Oct 1979).

38577 (LBL—10301, pp 378-384) **Calculations of major 3rd order geometric aberrations for final transport line.** Colton, E. (Argonne National Lab., IL). Sep 1980.

From Heavy ion fusion workshop; Berkeley, CA, USA (29 Oct 1979).

Karl Brown and Jack Peterson have presented a Final Transport Line for 10 GeV U^{+4}. The system consists of three 1/2 wave quadrupole sections and three dipoles. Furthermore, the system has been chromatically corrected to second-order utilizing two families of sextupoles. Some of the calculations are presented.

38578 (LBL—10301, pp 385-387) **Chromatic correction for the final transport system.** Brown, K.L. (Stanford Linear Accelerator Center, CA); Peterson, J.M. Sep 1980.

From Heavy ion fusion workshop; Berkeley, CA, USA (29 Oct 1979).

The final transport and focusing of the heavy-ion beam onto the fusion pellet in vacuum is complicated by several non-linear effects - namely, chromatic (momentum dependent) effects, geometric aberrations, and space-charge forces. This paper gives an example of how the chromatic effects can be nullified, at least to second order. Whether third- or higher-order terms are important is not yet clear. Space-charge effects are important but are not considered here.

38579 (LBL—10301, pp 388-390) **Coherent space charge instability of a two-dimensional beam.** Hofmann, I. (Max-Planck Inst., Garching/Muenchen, Germany). Sep 1980.

From Heavy ion fusion workshop; Berkeley, CA, USA (29 Oct 1979).

Results are presented of analytic calculations on the coherent space charge instabilities of a beam with initial Kapchinskij-Vladimirskij distribution and unequal emittances, rsp. average energy in the two transverse phase planes x-p/sub x/ and y-p/sub y/. We note that in computer simulation calculations evidence has been given for rapid emittance transfer to occur if the initial emittances ϵ/sub x/, ϵ/sub y/ are noticeably different. We have not attempted to make a quantitative comparison of our results with those from computer simulation. The main purpose of this study is to give some insight into the instability mechanism, the dimensionless parameters that characterize the situation and the growth rates one may expect to find.

38580 (LBL—10301, pp 391-395) **Numerical simulation of space charge aberrations in final focusing.** Haber, I. (Naval Research Lab., Washington, DC). Sep 1980.

From Heavy ion fusion workshop; Berkeley, CA, USA (29 Oct 1979).

38581 (LBL—10301, pp 396) **Spherical aberration from non-uniform space-charge.** Lawson, J.D. (Rutherford Lab., Chilton, England). Sep 1980.

From Heavy ion fusion workshop; Berkeley, CA, USA (29 Oct 1979).

38582 (LBL—10301, pp 397-402) **Studies of a beam line for transport to a target.** Garren, A. (Lawrence Berkeley Lab., CA). Sep 1980.

From Heavy ion fusion workshop; Berkeley, CA, USA (29 Oct 1979).

As an approach to some of the problems of final vacuum transport of intense beams, this note describes calculations to modify the beam line of Brown and Peterson to take account of space charge, and to assess its performance with respect to momentum spread and intensity variation along the bunch. Secondly a computational program is outlined for design of the sextupole chromatic correction system of beams with space charge, including a way to obtain their dispersion.

38583 (LBL—10301, pp 403-425) **Final transport in gas and plasma.** Olson, C.L. (Sandia National Labs., Albuquerque, NM). Sep 1980.

From Heavy ion fusion workshop; Berkeley, CA, USA (29 Oct 1979).

There exist several possible schemes for final transport of the heavy ion beam through the reactor chamber in the presence of a background gas or plasma. The optimization of the transport process depends significantly on the heavy ion beam parameters. It was the purpose of the working group on the final transport in gas and plasma to examine and assess the various transport schemes in view of the new HIF parameters and other recent developments. The results are summarized.

BEAM DYNAMICS, FIELD CALCULATIONS, AND ION OPTICS

REFER ALSO TO CITATION(S) 39170, 39172

38584 (BNL—27666) **Phenomenological analysis of current limits in storage rings.** Pellegrini, C.; Sands, M. (Brookhaven National Lab., Upton, NY (USA); California Univ., Santa Cruz (USA)). 1980. Contract AC02-76CH00016. 13p. (CONF-801101—1). NTIS, PC A02/MF A01.

From Japan-USA Seminar on synchrotron radiation facilities; Honolulu, HI, USA (5 Nov 1980).

The limitations on the current which can be stored in a storage ring was studied. A simple model is used for the impedance of the beam environment. Feedback systems are assumed to be used

to their full capacity to provide beam stability and that in the frequency range where feedback can no longer be used Landau damping will determine how much current can be stored in the ring. Estimates are made for proton storage rings and for electron storage rings of interest as synchrotron radiation sources and as colliding beam systems for high energy physics.

38585 (LA—8531-MS) **Three-dimensional space-charge calculation method.** Lysenko, W.P.; Wadlinger, E.A. (Los Alamos Scientific Lab., NM (USA)). Sep 1980. Contract W-7405-ENG-36. 9p. NTIS, PC A02/MF A01.

A method is presented for calculating space-charge forces on individual particles in a particle tracing simulation code. Poisson's equation is solved in three dimensions with boundary conditions specified on an arbitrary surface. When the boundary condition is defined by an impressed radio-frequency field, the external electric fields as well as the space-charge fields are determined. A least squares fitting procedure is used to calculate the coefficients of expansion functions, which need not be orthogonal nor individually satisfy the boundary condition.

38586 (LBL—10301, pp 58-62) **Space charge numerical simulation experiments.** Lapostolle, P.M. (Grand Accelerateur National d'Ions Lourds, Caen, France). Sep 1980.

From Heavy ion fusion workshop; Berkeley, CA, USA (29 Oct 1979).

Comments are presented here on the work contained in a CERN report. These comments are mainly oriented toward comparison with the work of I. Haber. The CERN work was performed about 10 years ago, at the same time as both numerical computations and experimental measurements of emittance growth in a linac were being carried out, in the hope of contributing to the understanding of the phenomena or of being the start of some theory.

38587 (LBL—10301, pp 94-116) **Emittance studies for heavy ion linac.** Jorna, S.; Janda, R. (Physical Dynamics, Inc., La Jolla, CA). Sep 1980.

From Heavy ion fusion workshop; Berkeley, CA, USA (29 Oct 1979).

A description is given of the phenomena which limit the allowable parameter range for beam and accelerator. Emittance calculations are presented for some typical beam parameters and a Wideroe structure.

38588 (LBL—10301, pp 126-150) **Impedances for electron linacs and storage rings.** Wilson, P.B. (Stanford Linear Accelerator Center, CA). Sep 1980.

From Heavy ion fusion workshop; Berkeley, CA, USA (29 Oct 1979).

Some basic concepts and results are presented concerning the impedances of electron linacs and storage rings. The impedances of an accelerator or ring completely characterizes the interaction of the beam with its environment. Not only does the impedance (or its Fourier transform, the wake potential) determine the energy loss by a bunched beam to its environment, but it is also the chief ingredient required for any calculation of beam stability.

38589 (LBL—10301, pp 182-186) **LIA longitudinal coupling impedance.** Faltens, A. (Lawrence Berkeley Lab., CA). Sep 1980.

From Heavy ion fusion workshop; Berkeley, CA, USA (29 Oct 1979).

The beam generated fields enter into the problems of waveform generation and longitudinal stability. In the former, provision must be made for the longitudinally defocusing forces due to the space charge and the beam loading effects on the accelerating voltage due to the current of a presumably known bunch. In the latter, the concern is for the growth of unintentional perturbations to unacceptably large values through the interaction of the charge and current fluctuations with the rest of the beam and the surrounding structures. These beam generated electric fields may be related to the beam current through a coupling impedance.

38590 (LBL—10301, pp 187-200) **Longitudinal dynamics of bunched beam in a model linac.** Kim, K.J. (Lawrence Berkeley Lab., CA). Sep 1980.

From Heavy ion fusion workshop; Berkeley, CA, USA (29 Oct 1979).

Some analytical efforts are reported on the longitudinal bunched beam dynamics in an induction linac as currently stipulated for the HIF program. The analysis is carried out within the framework of a simple model. It is found that a bunched beam tends to be stable.

38591 (LBL—10301, pp 201-231) **Longitudinal dynamics in heavy-ion induction linacs for inertial-fusion power plants.** Judd, D.L. (Lawrence Berkeley Lab., CA). Sep 1980.

From Heavy ion fusion workshop; Berkeley, CA, USA (29 Oct 1979).

Some implications of longitudinal phase space constraints are described. The behavior of small disturbances on a bunch varying in space and time is investigated. Some generalizations are given of Neuffer's self-consistent phase space distributions. (MOW)

38592 (LBL—10301, pp 245-252) **Stability of longitudinal motion in intense ion beams.** Neuffer, D. (Fermi National Accelerator Lab., Batavia, IL). Sep 1980.

From Heavy ion fusion workshop; Berkeley, CA, USA (29 Oct 1979).

Inertial confinement fusion using high energy heavy ion beams requires focussing of the igniting ion beams in longitudinal, as well as transverse, space at the pellet target. The focussing requirements set limits on the size of the beam emittances at the target, and obtaining sufficiently small emittances at the target requires sufficient stability in beam transport and acceleration from source to target, and an analysis of that stability is necessary for heavy ion fusion (HIF) accelerator design. Theoretical analysis is necessary since practical accelerator experience with high intensity non-relativistic ion beams has been limited. This analysis is particularly important for the case of a heavy ion induction linac, since previous induction linacs have been electron accelerators, and the highly relativistic electrons have negligible longitudinal motion. In this paper we present some results of our analysis of the stability of longitudinal motion.

38593 (LBL—10301, pp 327-373) **Longitudinal microwave instability.** Fenster, S. (Argonne National Lab., IL). Sep 1980.

From Heavy ion fusion workshop; Berkeley, CA, USA (29 Oct 1979).

A derivation of the relationship between growth rate and impedance is given. The only other instability considered here is the resonance effect produced by excessive tune shift due to space charge. We assume, without discussion, the $(\Delta\nu)$/sub max/ = .25; that is, this resonance growth is avoided (stability) by limiting the ring charge. On the other hand, the longitudinal microwave instability is assumed to be present (cannot be stabilized). Thus, the latter involves a limiting impedance to keep the growth rate low enough. The maximum allowed impedance for a maximum allowed growth rate is listed.

38594 (LBL—10301, pp 353-361) **Storage ring injection.** Burke, R.J. (Argonne National Lab., IL). Sep 1980.

From Heavy ion fusion workshop; Berkeley, CA, USA (29 Oct 1979).

Some basic issues involved in injecting the beam into storage rings with the principal parameters of those studied at the workshop have been considered. The main conclusion is that straightforward adjustments of the storage ring parameters makes injection easy. The largest number of injected turns is fourteen, and the phase space dilution allowance seems adequate to ensure very small beam loss during injection. The adjustments also result in lower bending magnet fields, and high field superconducting magnets (e.g., 5 Tesla) are not necessary. Finally, the impact of the parameters on cost is noted, and a system is considered that cuts the length of the linac in half by using doubly charged ions.

38595 (LBL—10301, pp 362-376) **Study of inter-beam interaction in injection processes at the space charge limit.** Takeda, H.; Fenster, S. (Argonne National Lab., IL). Sep 1980.

From Heavy ion fusion workshop; Berkeley, CA, USA (29 Oct 1979).

Augmenting a particle simulation program originally by I. Haber, beam dynamics of the injection process into a storage ring is studied. Although a real storage ring recently designed employs various kinds of magnetic elements, the essential features of its beam dynamics are determined by the quadrupole doublets. The lattice structure of the storage ring consists of 20 FODO periods.

38596 (SLAC-PUB—2543) **Beam-beam effect and luminosity in SPEAR.** Wiedemann, H. (Stanford Linear Accelerator Center, CA (USA)). Jul 1980. Contract AC03-76SF00515. 5p. (CONF-800740—22). NTIS, PC A02/MF A01.

From 11. international conference on high energy accelerators; Geneva, Switzerland (7 Jul 1980).

Measurements performed at SPEAR have been discussed and scaling laws for the maximum luminosity and the maximum linear tune shift parameter with energy are shown. There are two distinct regimes, one below 2 GeV where the linear tune shift parameter scales like ξ/sub y/ $\sim E^{2.4}$ and the other regime where this parameter is constant ξ/sub y/ $\simeq$ 0.05 to 0.06. In the lower energy regime the limit is reached when the vertical beam size is blown up to the acceptance of the storage ring. A significant ($<$ 10%) horizontal beam blow up is not observed and the value of the horizontal linear tune shift parameter ξ/sub x/ does not seem to be related to the beam-beam limit.

38597 (SLAC-PUB—2560) **Beam measurements on Argonne linac for collider injector design.** James, M.B.; Koontz, R.F.; Miller, R.H. (Argonne National Lab., IL (USA); Stanford Linear Accelera-

tor Center, CA (USA)). Jul 1980. Contract AC03-76SF00515. 5p. (CONF-800740—17). NTIS, PC A02/MF A01.

From 11. international conference on high energy accelerators; Geneva, Switzerland (7 Jul 1980).

The 20 MeV electron linac at Argonne produces 5 x 10^{10} electrons in a single bunch. This amount of charge per bunch is required for the proposed single pass collider at SLAC. For this reason the characteristics of the beam from this machine are of interest. The longitudinal charge distribution has been measured by a new technique. The technique is a variation on the deduction of bunch shape from a spectrum measurement. Under favorable conditions a resolution of about 1° of phase is possible, which is considerably better than can be achieved with streak cameras. The bunch length at 4.5 x 10^{10} e^- per bunch was measured to be 15° FWHM. The transverse emittance has also been measured using standard techniques. The emittance is 16 mm-mrad at 17.2 MeV.

38598 (SLAC-PUB—2561) **Transverse wake field effects on intense bunches with application to the SLAC linear collider.** Chao, A.W.; Richter, B.; Yao, C.Y. (Stanford Linear Accelerator Center, CA (USA)). Jul 1980. Contract AC03-76SF00515. 6p. (CONF-800740—18). NTIS, PC A02/MF A01.

From 11. international conference on high energy accelerators; Geneva, Switzerland (7 Jul 1980).

The theory of transverse beam break-up is summarized and briefly discussed in this paper. It is then applied to the SLAC linear accelerator to give the various design tolerances for beam injection and alignment of accelerator components for the linear collider operation.

AUXILIARIES AND COMPONENTS

38599 (LBL—10301, pp 253-261) **Storage ring group summary.** King, N.M. (Rutherford High Energy Lab., Chilton, England). Sep 1980.

From Heavy ion fusion workshop; Berkeley, CA, USA (29 Oct 1979).

The Storage Ring Group set out to identify and pursue salient problems in accelerator physics for heavy ion fusion, divorced from any particular reference design concept. However, it became apparent that some basic parameter framework was required to correlate the different study topics. As the Workshop progressed, ring parameters were modified and updated. Consequently, the accompanying papers on individual topics will be found to refer to slightly varied parameters, according to the stage at which the different problems were tackled.

38600 (LBL—10301, pp 262-291) **Beam injection and accumulation method in storage rings for heavy ion fusion.** Katayama, T.; Noda, A.; Tokuda, N.; Hirao, Y. (Univ. of Tokyo, Japan). Sep 1980.

From Heavy ion fusion workshop; Berkeley, CA, USA (29 Oct 1979).

A combination of multiturn injection and rf stacking is proposed as an efficient beam injection method in storage rings for heavy ion fusion. Five turn injection in each transverse phase space and four rf stackings give a total of 100 stacking turns. This represents a compromise between the tolerable emittances and momentum spread in the ring. Space charge limitations and coherent beam instabilities are investigated. The most severe limit is found to be the transverse coherent instability, but this can be controlled by the use of sextupole and octupole magnetic fields. Assuming a charge exchange cross section of 1 x 10^{-15} cm^2, the e-folding life time is estimated at 180 ms, while the stacking time is 40 ms.

38601 (LBL—10301, pp 292-293) **Beam loss in the storage ring complex due to charge exchange scattering.** Le Duff, J.R.; Maidment, J.R. (Rutherford Lab., Chilton, England). Sep 1980.

From Heavy ion fusion workshop; Berkeley, CA, USA (29 Oct 1979).

The beam loss due to charge exchange scattering for the three reference designs used during this study is estimated. The formula derived under simplifying assumptions is similar to that used previously by Mills. Our results show that this effect is by no means negligible and indicate a need for both more complete calculations and further experimental data on charge exchange cross-sections for specific ions.

38602 (LBL—10301, pp 294-296) **Beam scraping problems in storage rings: the black cloud.** Jones, L.W. (Michigan Univ., Ann Arbor). Sep 1980.

From Heavy ion fusion workshop; Berkeley, CA, USA (29 Oct 1979).

The heavy ion, multi-GeV drivers for inertial confinement fusion are being designed to produce beams of an energy, power, and specific ionization sufficient to raise matter to thermonuclear temperatures. The magnitude of these parameters is so far beyond current experience that some problems raised warrant careful scrutiny. In particular, the consequence of some fraction of the beam lost on storage ring inflection septa, extraction channels, and beam-defining collimators seems potentially very serious. Unless carefully contained, a beam halo can easily vaporize the best refractory materials, and the resulting vapor cloud will interact destructively within microseconds with the following beam. The limits on beam flux which may be so lost for particular examples are orders of magnitude below current experience.

38603 (LBL—10301, pp 297-304) **Bunch compression in heavy ion fusion storage rings.** Cornacchia, M. (Brookhaven National Lab., Upton, NY); Rees, G.H. Sep 1980.

From Heavy ion fusion workshop; Berkeley, CA, USA (29 Oct 1979).

Bunch compression in the proposed heavy ion fusion storage rings results in large transverse and longitudinal space charge forces. In this note, parameters are derived for the bunch compression in three reference designs, and aspects of the transverse and longitudinal motion are discussed. Transverse and longitudinal space charge forces on an ion depend on both the transverse and azimuthal coordinates of the ion in the bunch. It therefore appears to be insufficient to treat the transverse and longitudinal motions separately in the non-adiabatic compression, and that a detailed evaluation of the problem requires elaborate numerical simulation or an experimental test facility.

38604 (LBL—10301, pp 310-312) **Integer resonance crossing in heavy ion accumulator ring.** Le Duff, J. (Rutherford Lab., Chilton, England). Sep 1980.

From Heavy ion fusion workshop; Berkeley, CA, USA (29 Oct 1979).

Two simple approaches are considered for the transient particle dynamics when the operating tune is very close to an integer resonance and assuming dipole defects are distributed around the ring.

38605 (LBL—10301, pp 313-314) **Lifetime of ion beam in an accumulation ring.** Katayama, T.; Noda, A.; Tokuda, N. (Univ. of Tokyo, Japan). Sep 1980.

From Heavy ion fusion workshop; Berkeley, CA, USA (29 Oct 1979).

Beam loss due to charge exchange processes may be a severe obstacle to accumulating intense ion beams in a storage ring. Here, the loss rate is estimated for a ring where Xe^{4+} ions are supposed to be accumulated.

ION SOURCES

38606 (LA-tr—80-27) **Construction of a device for argon charge reversal and a Wien filter for a source of polarized protons and deuterons.** Krause, H.H. (Giessen Univ. (Germany, F.R.). Inst. fuer Kernphysik). Sep 1980. Translation source information not available . 18p. NTIS, PC A02/MF A01.

Construction of a Wien filter for rotating the quantization axis of the nuclear spin polarization of hydrogen and deuterium ions is described. (GHT)

EXPERIMENTAL FACILITIES AND EQUIPMENT

38607 (CONF-8006123—1) **25 MV tandem accelerator at Oak Ridge.** Jones, C.M. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 17p. NTIS, PC A02/MF A01.

From 5. tandem conference; Catania, Italy (9 Jun 1980).

A new heavy-ion accelerator facility is under construction at the Oak Ridge National Laboratory. A brief description of the scope and status of this project is presented with emphasis on the first operational experience with the 25 MV tandem accelerator.

38608 (LA—8521-MS) **Pyrographite water-cooled target analysis.** Bennett, G.A. (Los Alamos Scientific Lab., NM (USA)). Sep 1980. Contract W-7405-ENG-36. 10p. NTIS, PC A02/MF A01.

This report presents a study of two pyrographic water-cooled targets planned for use in the Clinton P. Anderson Meson Physics Facility. A steady-state thermal stress analysis was done that included a parameter study on the physical and numerical variables that affect the problem. The maximum target temperatures and stresses were calculated and compared for a variety of conditions. The comparisons show that the 0.6-cm half-width fin target proposed for the A-2 line is the most vulnerable of the targets analyzed.

38609 (ORNL/Sub—80/21453/3) **60 GHz gyrotron development program. Quarterly report No. 3, January-March 1980.** Shively, J.F.; Stone, D.S.; Wendell, G.E. (Varian Associates, Palo Alto, CA (USA). Palo Alto Microwave Tube Div.). 1980. Contract W-7405-ENG-26. 46p. NTIS, PC A03/MF A01.

The current objective of this program is to develop a microwave oscillator capable of producing 200 kW of CW output power at 60 GHz. The use of cyclotron resonance interaction is being pursued. The early design phases of this program are discussed.

38610 (SAND—80-1364C) **Ion beam characteristics of a gas filled accelerator tube.** Berg, R.S.; Bickes, R.W. Jr.; Boers, J.E.; Shope, L.A. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 12p. (CONF-801037—10). NTIS, PC A02/MF A01.

From American Vacuum Society conference; Detroit, MI, USA (13 Oct 1980).

A gas filled tube used to produce a pulsed neutron flux with the D(T,^{4}He)n reaction is described. Deuterium and tritium ions generated in a reflex discharge are extracted and accelerated to 100 keV by means of an accelerator electrode onto a deutero-tritide target electrode. The electrodes are designed to focus the ion beam onto the target. Total tube currents consisting of extracted ions, unsuppressed secondary electrons, and ions generated by interactions with the background gas are typically 100mA. Characteristics of the extracted ion beam are discussed. Accelerating voltages greater than 50kV are required to focus the beam through the accelerator aperture for configurations that give beams with the proper energy density at the target. The perveance of the beam is defined. Maximum perveance values are 2 to 10 nanopervs. Tube focussing and neutron production characteristics are described.

38611 (SAND—80-1911) **Intense neutron source: high-voltage power supply specifications.** Riedel, A.A. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1980. Contract AC04-76DP00789. 14p. NTIS, PC A02/MF A01.

This report explains the need for and sets forth the electrical, mechanical and safety specifications for a high-voltage power supply to be used with the intense neutron source. It contains sufficient information for a supplier to bid on such a power supply.

38612 (SLAC-PUB—2559) **RF systems and accelerating structures for linear colliders.** Loew, G.A.; Wilson, P.B. (Stanford Linear Accelerator Center, CA (USA)). Jul 1980. Contract AC03-76SF00515. 5p. (CONF-800740—19). NTIS, PC A02/MF A01.

From 11. international conference on high energy accelerators; Geneva, Switzerland (7 Jul 1980).

This paper presents some of the new design requirements for linear colliders and describes the types of RF systems and accelerating structures that might produce very high energies and gradients within reasonable power consumption limits. Directions for future research are indicated.

38613 (UCRL-Trans—11616) **Possibilities for increasing the efficiency and plasma velocity in a pulsed coaxial accelerator.** Belikov, A.G.; Goncharenko, D.K.; Goncharenko, V.P.; Derepovskii, N.T. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). Jul 1980. Translation of KHFTI—79-64, 1979. 43p. NTIS, PC A03/MF A01.

The paper considers a model of a pulsed plasma accelerator in which allowance is made for a nonuniform initial distribution of the working gas. The optimal conditions are obtained for the efficiency of the accelerator and for the plasma velocity on the assumption of complete ionization of the working gas before the start of discharge in the accelerator. The paper treats the real case of a neutral working gas whose ionization is accomplished as the plasma is accelerated. It is shown that by appropriate selection of parameters, the operating conditions of the accelerator can be brought up to the case considered previously. It is desirable to use initial preionization, which may have a substantial effect on the process of plasma acceleration. The model of acceleration with a working gap of variable cross section is considered. It is shown that when an optimal selection is made of the electrode profile, the requirements on the initial distribution of working gas become less stringent. The paper gives recommendations on the selection of the electrode configuration.

38614 **Daresbury isotope separator and recoil separator projects.** Nolan, P.J. (Univ. of Liverpool, England). pp 103-107 of Future directions in studies of nuclei far from stability. Hamilton, J.H.; Spejewski, E.H.; Bingham, C.R.; Zganjar, E.F. (eds.). New York, NY; North-Holland Publishing Co. (1980).

From International symposium on future directions in studies of nuclei far from stability; Nashville, TN, USA (10 Sep 1979).

The Nuclear Structure Facility currently being constructed at Daresbury Laboratory will have a 30 MV Tandem Van de Graaff accelerator capable of producing a wide range of beams. An on-line isotope separator is being designed, which will be coupled directly to several pieces of experimental apparatus including a dilution refrigerator that will be used for nuclear orientation studies. A recoil separator is also being designed which will be used both for spectroscopic studies far from stability and in the search for superheavy elements. 3 figures.

38615 **New Orsay on line separator ISOCELE and the beginning of its exploitation for nuclear research.** Berg, V. (Institut de Physique Nucleaire, Orsay, France). pp 353-363 of Future directions in studies of nuclei far from stability. Hamilton, J.H.; Spejewski, E.H.; Bingham, C.R.; Zganjar, E.F. (eds.). New York, NY; North-Holland Publishing Co. (1980).

From International symposium on future directions in studies of nuclei far from stability; Nashville, TN, USA (10 Sep 1979).

The transformation of the Orsay synchrocyclotron increasing the extracted particle beam intensity by a factor 30 has led to a total reconstruction of the on-line separator ISOCELE. The characteristics of the new separator and results of the first target tests are presented. 10 figures, 1 table.

STORAGE RINGS

REFER ALSO TO CITATION(S) 38584, 38953

38616 (BNL—28266) **Selection and evaluation of an ultra high vacuum gate valve for Isabelle beam line vacuum system.** Foerster, C.L.; McCafferty, D. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 16p. (CONF-801037—4). NTIS, PC A02/MF A01.

From American Vacuum Society conference; Detroit, MI, USA (13 Oct 1980).

A minimum of eighty-four (84) Ultra High Vacuum Gate Valves will be utilized in ISABELLE to protect proton beam lines from catastrophic vacuum failure and to provide sector isolation for maintenance requirements. The valve to be selected must function at less than 1×10^{-11} Torr pressure and be bakeable to 300°C in its open or closed position. In the open position, the valve must have an RF shield to make the beam line walls appear continuous. Several proposed designs were built and evaluated. The evaluation consisted mainly of leak testing, life tests, thermal cycling, mass spectrometer analysis, and 10^{-12} Torr operation. Problems with initial design and fabrication were resolved. Special requirements for design and construction were developed. This paper describes the tests on two final prototypes which appear to be the best candidates for ISABELLE operation.

38617 (SLAC-PUB—2552) **Chromatic corrections for large storage rings.** Brown, K.L.; Servranckx, R.V. (Stanford Linear Accelerator Center, CA (USA); Saskatchewan Univ., Saskatoon (Canada)). Jun 1980. Contract AC03-76SF00515. 5p. (CONF-800740—15). NTIS, PC A02/MF A01.

From 11. international conference on high energy accelerators; Geneva, Switzerland (7 Jul 1980).

The second-order achromat princople is used to correct the chromatic aberrations in a representative 75 GeV/c storage ring using four families of sextupoles. The ring chosen to illustrate the essential principles of the design procedure has the following general characteristics: Beam Energy = 75 GeV; Beta*(x) = 1.6 m; Beta*(y) = 0.1 m; Circumference = 25 km.

38618 (SLAC-PUB—2553) **PEP instrumentation and control system.** Melen, R. (Stanford Linear Accelerator Center, CA (USA)). Jun 1980. Contract AC03-76SF00515. 12p. (CONF-800740—21). NTIS, PC A02/MF A01.

From 11. international conference on high energy accelerators; Geneva, Switzerland (7 Jul 1980).

This paper describes the operating characteristics of the primary components that form the PEP Instrumentation and Control System. Descriptions are provided for the computer control system, beam monitors, and other support systems.

38619 (SLAC-PUB—2555) **P.E.P.** Paterson, J.M. (Stanford Linear Accelerator Center, CA (USA); California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1980. Contract AC03-76SF00515. 8p. (CONF-800740—16). NTIS, PC A02/MF A01.

From 11. international conference on high energy accelerators; Geneva, Switzerland (7 Jul 1980).

The design and construction of the PEP project is briefly reviewed. The initial testing of the storage ring system and its present performance is described. The short-range plans for continuing development are discussed.

INSTRUMENTATION

RADIATION INSTRUMENTATION

REFER ALSO TO CITATION(S) 37753

GENERAL DETECTORS AND MONITORS

REFER ALSO TO CITATION(S) 37756, 38124, 38166

38620 (BNL—28328) **Performance and development of dE/dx counters.** Walenta, A.H. (Brookhaven National Lab., Upton, NY (USA)). Sep 1980. Contract AC02-76CH00016. 85p. (CONF-800684—8). NTIS, PC A05/MF A01.

From International conference on experimentation at LEP; Uppsala, Sweden (16 Jun 1980).

The performance of existing or nearly completed detectors for particle identification by using the relativistic rise of energy loss will be discussed. Detailed analysis of systematic errors leads finally to large detector systems approaching the ultimate resolution as measured in small test devices. New methods for extracting the information from the counter with the potential of better particles separation than standard dE/dx will be presented. It includes very fine sampling, δ-ray clipping, and cluster counting.

38621 (LBL—9651) **Detectors for radiation dosimetry.** Perez-Mendez, V. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1979. Contract W-7405-ENG-48. 39p. (CONF-7909130—1). NTIS, PC A03/MF A01.

From Conference on advances in radiation protection and dosimetry in medicine; Erici, Sicily, Italy (16 Sep 1979).

For our purposes in this review, we note the following points: (1) for charged particle detection, these counters can be filled with any noble gas-quenching gas mixture that produces satisfactory electrical signals; (2) neutron counters, in which the neutrons are detected by their interaction with the specific filling of the chamber to yield an ionizing particle, require special gas mixtures containing ^3He or BF_3, an alternative approach is to coat the inner surface of the cathode with a boron or lithium compound; (3) proportional counters are used if there is any need to discriminate between different types of radiation incident on the chamber by the magnitude of the ionizing energy retained within the sensitive volume of the counter; (4) proportional counters can operate at higher speeds than Geiger counters, typically up to 10^7 cts/sec versus less than 10^8/sec for the Geiger counters; and (5) Geiger counters produce very large uniform pulses which can be scaled by very simple electronics, hence, they are often used in survey meters and other portable monitoring instruments.

38622 **γ-free Si(Li) detector for ISOL.** Toriyama, T.; Nishio, T.; Kanbe, M.; Hisatake, K. (Tokyo Inst. of Technology, Japan). pp 97-102 of Future directions in studies of nuclei far from stability. Hamilton, J.H.; Spejewski, E.H.; Bingham, C.R.; Zganjar, E.F. (eds.). New York, NY; North-Holland Publishing Co. (1980).

From International symposium on future directions in studies of nuclei far from stability; Nashville, TN, USA (10 Sep 1979).

A γ-free detector system, which consists of a proportional counter and a Si(Li) detector as a counter telescope, has been constructed and tested. The proportional counter used is of pure methane gas (CH_4) of one atm. With the present detector system the Compton edge was reduced to be order of 10^{-3} in the case of ^{206} ^{207}Bi. Two quanta escape pair peaks were also found to disappear in the test experiment of ^{56}Co.

RADIATION DOSEMETERS

38623 (LASL—80-35(MINI-REV.)) **New small devices for radiation detection: the Wee Pocket Chirper and the Portable Multichannel Analyzer.** Umbarger, C.J. (Los Alamos Scientific Lab., NM (USA)). Aug 1980. Contract W-7405-ENG-36. 4p. NTIS, PC A02/MF A01.

Recent events have demonstrated the need for improved capability to monitor the exposure of workers to radiation and, in general, to identify and measure the many forms of radioactive materials found throughout the nuclear industry. Two radiation monitoring devices have been developed that are much smaller than existing instruments, yet exhibit superior performance and a longer battery life. The first instrument, the Wee Pocket Chirper, is a tiny, battery-powered warning device that chirps when exposed to radiation. The second instrument is a portable battery-powered, computer-based, multichannel analyzer that allows the user to examine radiation fields and to identify the types and amounts of radioactive materials present.

38624 (ORNL/TM—7477) **Whole body counting facility at Oak Ridge National Laboratory. Systems and procedure review.** Berger, C.D.; Goans, R.E.; Greene, R.T. (Oak Ridge National Lab., TN (USA)). Oct 1980. Contract W-7405-ENG-26. 52p. NTIS, PC A04/MF A01.

The design and operation of the ORNL whole body counter is described and discussed. An introduction to the mini-computer system used to operate the facility is included. (ACR)

NUCLEAR SPECTROSCOPIC INSTRUMENTATION

38625 (CONF-800426—3) **Supralinearity of peak 5 and peak 6 in TLD-700.** Waligorski, M.P.R.; Katz, R. (Nebraska Univ., Lincoln (USA)). 1980. Contract AS02-76EV01671. 9p. NTIS, PC A02/MF A01.

From 6. international conference on solid state dosimetry; Toulouse, France (1 Apr 1980).

Track Theory has been applied to an earlier suggestion, that the supralinearity of TLD's at high gamma-ray doses is due to pre-existing 1-hit and 2-hit trap structures, to calculate high-LET response. Measured ^{60}Co responses for peaks 5 and 6 in LiF(TLD-700) were decomposed to yield parameters characterizing each peak as a 2-component c-hit mixture. One value of trap radius was assigned to each 2-component representation, different for peak 5 and for peak 6, to calculate their responses for H, He, C, O, and Ne bombardments. Calculations reproduce experimental features of the heavy-ion response of TLD-700, and provide means of connecting the gamma and high-LET responses in thermoluminescent dosimeters.

38626 (HEDL-SA—2111-5) **Janus probe, a detection system for high energy reactor gamma-ray spectrometry.** Gold, R.; Kaiser, B.J. (Hanford Engineering Development Lab., Richland, WA (USA)). Mar 1980. Contract AC14-76FF02170. 6p. (CONF-800942—16). NTIS, PC A02/MF A01.

From ANS topical meeting on 1980 advances in reactor physics and shielding; Sun Valley, ID, USA (14 Sep 1980).

In reactor environments, gamma-ray spectra are continuous and the absolute magnitude as well as the general shape of the gamma continuum are of paramount importance. Consequently, conventional methods of gamma-ray detection are not suitable for in-core gamma-ray spectrometry. To meet these specific needs, a method of continuous gamma-ray spectrometry, namely Compton Recoil Gamma-Ray Spectrometry, was developed for in-situ observations of reactor environments. A new gamma-ray detection system has been developed which extends the applicability of Compton Recoil Gamma-Ray Spectrometry up to roughly 7 MeV. This detection system is comprised of two separate Si(Li) detectors placed face-to-face. Hence this new detection system is called the Janus probe. Also shown is the block diagram of pulse processing instrumentation for the Janus probe. This new gamma probe not only extends the upper energy limit of in-core gamma-ray spectrometry, but in addition possesses other fundamental advantages.

38627 (LBL—9711, pp 237-239) **Plastic Ball-a multi-detector, large solid angle spectrometer with charged particle identification for the Bevalac.** Gutbrod, H.H.; Maier, M.R.; Meyer, W.G.; Peter, J.; Poskanzer, A.M.; Ritter, H.G.; Stelzer, H.; Stock, R.; Welk, F.; Wolf, K.L. Mar 1980.

In Nuclear science. Annual report, July 1, 1978-June 30, 1979.

Design and performance of the Plastic Ball detector are described. The Plastic Ball identifies light charged particles with a solid angle of 96% of 4π. 2 figures. (RWR)

38628 (UCRL—84536) **Detection efficiency of Ge(Li) and HPGe detectors for γ-rays up to 10 MeV.** Lin, J.; Henry, E.A.; Meyer, R.A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Aug 1980. Contract W-7405-ENG-48. 9p. (CONF-801111—1). NTIS, PC A02/MF A01.

From 6. conference on application of accelerators in research and industry; Denton, TX, USA (Nov 1980).

The relative efficiency up to 9.7 MeV was calibrated for two coaxial detectors, one Ge(Li) and one high purity Ge. The efficiency curves were determined by using a combination of standard radioactive sources and (n,γ) reactions. Based on the result of this work, the general slope of the two detector efficiency curves appears to be similar and in agreement with earlier work reported by McCallum and Coote. When plotted as a semilogarithmic function of energy the efficiency is linear from 2 to 9.7 MeV.

HIGH ENERGY PHYSICS INSTRUMENTATION

38629 (DOE/ER/14529—1) **Performance characteristics of large aperture, ten-cell, atmospheric pressure isobutane Cherenkov counters.** Hylen, J.; Ma, Z.M.; Jawahery, A.; Maruyama, T.; Milburn, R.; Thornton, R. (Michigan State Univ., East Lansing (USA). Dept. of Physics; Tufts Univ., Medford, MA (USA). Dept. of Physics). 24 May 1980. Contract AS02-77ER14529. 25p. NTIS, PC A02/MF A01.

Two large aperture, 10 cell atmospheric-pressure isobutane Cherenkov counters were designed and constructed for a SLAC streamer chamber experiment. The rejection efficiencies for a 9 GeV/c π^- were measured to be 99.838 +- .006% and 99.717 +- 008% for the two counters. The design details and performance characteristics are discussed.

MISCELLANEOUS INSTRUMENTS

REFER ALSO TO CITATION(S) 37504, 38385, 38413, 38517, 38802, 38883

38630 (SAND—79-2313) **Versatile microcomputer-based temperature controller.** Yarberry, V.R. (Sandia Labs., Albuquerque, NM

(USA)). Sep 1980. Contract AC04-76DP00789. 51p. NTIS, PC A07/MF A01.

The wide range of thermal responses required in laboratory and scientific equipment requires a temperature controller with a great deal of flexibility. While a number of analog temperature controllers are commercially available, they have certain limitations, such as inflexible parameter control or insufficient precision. Most lack digital interface capabilities—a necessity when the temperature controller is part of a computer-controlled automatic data acquisition system. We have developed an extremely versatile microcomputer-based temperature controller to fulfill this need in a variety of equipment. The control algorithm used allows optimal tailoring of parameters to control overshoot, response time, and accuracy. This microcomputer-based temperature controller can be used as a standalone instrument (with a teletype used to enter para-meters), or it can be integrated into a data acquisition system (with a computer used to pass parameters by way of an IEE-488 instrumentation bus).

38631 (SAND—80-1286) **Film transporting curved crystal x-ray spectrometer.** Morrison, L.W. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1980. Contract AC04-76DP00789. 14p. NTIS, PC A02/MF A01.

Engineers at Sandia National Laboratories have designed and developed a new spectrometer to measure the energy of incident x-rays. Unlike current spectrometers that can record only one exposure, the new device can record up to 25 exposures of individual x-ray spectra without need to remove the film. It is compact (less than 15 cm across) yet holds more than 7 m of x-ray-sensitive film. Although designed for a special purpose, it can be used for any system that produces x-rays.

38632 (UCRL—50025-80-1, pp 5-9) **Computer-controlled calibration system automatically calibrates data acquisition systems.** 1 Apr 1980.

In Electronics Engineering Department. Quarterly report No. 1, 1980.

An automatic calibration system electronically patches calibration signals into the data path of transducers in data acquisition systems. This is a major improvement over previous methods of manually patching these signals. 4 figures.

38633 (UNI-TR—4) **Ultrasonic flowmeters: a progress report.** Wittekind, W.D. (UNC Nuclear Industries, Inc., Richland, WA (USA)). 12 Nov 1980. Contract AC06-76RL01857. 61p. NTIS, PC A04/MF A01.

This progress report describes the components and system configuration of the prototype ultrasonic flowmeter and initial flow testing. It is the second in a series of progress reports on the development and testing of ultrasonic flowmetering concepts. The greatest advantage of an ultrasonic flowmeter is that the instrument can be installed on the outside of a pipe with no modifications required. The flow is measured through the pipe walls. However, complex electronic systems are needed for the measurements. The ultrasonic flowmeter features: high resolution limited only by the electronics; fast response since there are no moving parts; measurement over a wide range of flow conditions; portability; and can be used for a range of different pipe sizes. No current alternative method of measuring flow combines all these advantages.

38634 **Counting the atoms.** Hurst, G.S.; Payne, M.G.; Kramer, S.D.; Chen, C.H. (Health and Safety Research Division, Oak Ridge National Laboratory). W-7405-ENG-26. *Phys. Today;* **33**: No. 9, 24-29(Sep 1980).

Practically every element in the periodic table can be detected, down to single-atom sensitivity, by resonance-ionization-spectroscopy methods involving commercially available lasers.

38635 **Apparatus for maintaining aligment of a shrinking weld joint in an electron-beam welding operation.** Trent, J.B.; Murphy, J.L. (to Dept. of Energy). US Patent Application 109,364. 3 Jan 1980. 11p.

The invention is directed to an apparatus for automatically maintaining a shrinking weld joint in alignement with an electron beam during an electron-beam multipass-welding operation. The apparatus utilizes a bias means for continually urging a workpiece-supporting face plate away from a carriage mounted base that rotatably supports the face plate. The extent of displacement of the face plate away from the base in indicative of the shrinkage occuring in the weld joint area. This displacement is measured and is used to move the base on the carriage a distance equal to one-half the displacement for aligning the weld joint with the electron beam during each welding pass.

EXPLOSIONS AND EXPLOSIVES

CHEMICAL

REFER ALSO TO CITATION(S) 38550

38636 (MHSMP—80-43) **Moisture retardation of micronized TATB pellets through Parylene coating.** Stull, T.W.; Sandoval, J. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). Sep 1980. Contract AC04-76DP00487. 8p. NTIS, PC A02/MF A01.

Initial efforts to determine if Parylene coating of micronized TATB pellets is effective in retarding moisture adsorption are described. Machined and pressed pellets (2.5 cm diameter x 2.5 cm height) at densities of approximately 1.8 g/cc, both coated and uncoated, were placed in relative humidity desiccators at ambient temperature for a period of 13 weeks. Gain in weight and dimensional growth were monitored by periodic weighing and dimensional measurements. It was found that Parylene coating reduces the rate at which micronized TATB pellets adsorb moisture. This reduction is dependent on relative humidity. As humidity increases, the protection afforded by the Parylene coating decreases. At the end of the study two pellets were dried for 24 hours at 100°C and their weights returned to slightly less than original. Moisture uptake therefore appears to be primarily surface adsorption. No significant dimensional growth occurred over the 13-week study.

38637 (MHSMP—80-47) **Hydra Hammer Manifold and MDC tip characterization (normal mode).** Avara, G.R.; Warren, T.W. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). Sep 1980. Contract AC04-76DP00487. 54p. NTIS, PC A04/MF A01.

Dynamic tests were performed on prototype designs of manifold and mild detonating cord (MDC) components for the Hydra Hammer Disablement System. MDC end tips and manifold formed flyers, axial and radial, were photograhically covered to determine flyer shapes, velocities, and transit times.

38638 (MHSMP—80-48) **ODTX test program.** Schmitz, G.T.; Faubion, B.D. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). Oct 1980. Contract AC04-76DP00487. 17p. NTIS, PC A02/MF A01.

Cylindrical geometries of plastic bonded HMX, RDX, TATB, and NQ in various formulations were tested at intermediate temperatures. Explosive samples were confined in aluminum pressure vessels so that early thermal reaction products were contained with the explosive sample. Time/temperature histories were recorded for each test. The Pantex Plant version of the one dimension time-to-explosion test uniquely offers a vehicle to characterize thermal properties of explosive formulations at nominal densities, in substantial quantity, and in confinement, all states heretofore not combined in large scale configurations, to categorize physical properties.

38639 (MHSMP—80-52) **Analysis of nitrocellulose and tris-beta-chloroethyl phosphate in PBX 9404 by high performance liquid chromatography.** Richardson, B.R. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). Oct 1980. Contract AC04-76DP00487. 8p. NTIS, PC A02/MF A01.

A procedure for determining the nitrocellulose and tris-beta-chloroethyl phosphate content in PBX 9404 by high performance liquid chromatography is discussed. For a sample which contained 2.88% NC, 2.87% was found with a standard deviation of 0.02%. The same sample, known to contain 2.72% CEF, was found to be composed of 2.69% CEF with a standard deviation of 0.04%.

38640 (SRI-PYU—25594) **Exploratory research. Task IV. Synthesis. Final report, April 1, 1973-March 31, 1975.** Simon, R.L.; Coon, C.L. (Stanford Research Inst., Menlo Park, CA (USA)). 31 Mar 1975. Contract AT03-76SF80021. 93p. NTIS, PC A05/MF A01.

An investigation was conducted of the chemistry of compounds that contain fluorine and nitro groups with the objective of providing materials useful as plasticizers, monomers, and binders for explosive compositions. The approach was to use new and existing chemistry to produce new fluoronitro compounds. Nitro groups were necessary for energy and low volatility; fluorine, for energy and improvement of physical properties, e.g., glass transition temperature (tg) and chemical and thermal stability. The major objectives were the preparation of pound quantities of ADDF, MFF, and TFMFF, and the synthesis of new candidate liquid carriers and binders. Four pounds ADDF, two pounds MFF and two pounds TFMFF were prepared. Samples of three new plasticizers, OTT, HTD, and DFNE were also supplied to LLL. Work began on a number of candidate binders and a new method for the synthesis of the -OCF_2O- moiety. Continued investigation in a number of promising areas of research is recommended. (LCL)

38641 (UCID—18785) **Analysis of explosive composite RX-14-AE: HMX/polyethylene/oleic acid.** Selig, W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Aug 1980. Contract W-7405-ENG-48. 11p. NTIS, PC A02/MF A01.

To a sample of the explosive, water was added and the oleic acid converted to the sodium salt by adjusting the pH to 12.2 to 12.5. The sodium oleate was titrated potentiometrically with standard cetylpyridinium chloride. Another sample was dissolved in dimethylsulfoxide and the HMX was titrated vs standard tetrabutylammonium hydroxide. Polyethylene was calculated by difference.

NUCLEAR

WEAPONRY

38642 (AD—A078561/8) **Exercise DESERT ROCK VII and VIII. Annex 1.** (Exercise Desert Rock, Las Vegas, NV (USA)). 1957. 251p. NTIS, PC A12/MF A01.

Contents: Atomic Bursts Priscilla and Smoky; General Information; Technical Consideration - Shot Priscilla; Equipment Display - Shot Priscilla; Damage Comparison - Predicted vs Actual - Shot Priscilla; Pre and Post Shot Photos - Shot Priscilla; Technical Considerations - Shot Smoky; Equipment Display - Shot Smoky; Damage Comparison - Predicted vs Actual - Shot Smoky; and Pre and Post Shot Photos - Shot Smoky.

38643 (AD—A078565/9) **Exercise DESERT ROCK IV, April-June 1952.** (Exercise Desert Rock, Las Vegas, NV (USA)). 1952. 245p. NTIS, PC A11/MF A01.

The overall purpose of the report is to provide all branches of the Armed Forces with the latest information available from Exercise DESERT ROCK IV, for use in study and planning in connection with the possible employment of atomic weapons. While the principal mission of the exercise was the indoctrination of troops and observers, attention was also given to blast and thermal effects on troop equipment, materiel, and emplacements under field conditions, and on live animals. Information contained in the report is factual, but results from a series of single detonations of atomic devices of differing KT yields, differing methods of delivery, and differing heights of burst. Since no two detonations covered in the report had identical background, results from each detonation must be considered separately, and caution must be exercised in generalizing from this report on possible effects at predetermined distances from ground zero.

ENVIRONMENTAL SCIENCES, ATMOSPHERIC

BASIC STUDIES

REFER ALSO TO CITATION(S) 37815, 37980, 37981, 39227

38644 (CONF-7906180—) **Proceedings of the workshop on the modification of the upper atmosphere by Satellite Power System (SPS) propulsion effluents.** Bauer, E. (La Jolla Inst., CA (USA)). Jun 1980. Contract W-31-109-ENG-38. 132p. NTIS, PC A07/MF A01.

From Workshop on the modification of the upper atmosphere by satellite power system pollution effluence; La Jolla, CA, USA (25 Jun 1979).

Results of a workshop held in June 1979, to identify research needs for evaluating environmental impacts on the upper atmosphere (here defined as greater than 70 km) due to Satellite Power System (SPS) transport, i.e., propulsion and reentry are presented. The substantial injections of water and hydrogen therefrom may lead to global-scale regions of reduced ionization in the ionospheric F-Region that may have a serious impact on worldwide HF radio communications; and the resulting possibly significant increases in mesospheric humidity and probable cloudiness could afffect climate and remote sensing from satellites. The large injections of argon ions of kilovolt energy between low earth orbit and geostationary orbit may alter substantially the trapped radiation environment of the magnetosphere and thus the hazard for personnel and electronic equipment. During the workshop it became clear that the highest priority for SPS environmental assessment goes to theoretical studies needed before acceptable atmospheric experiments can be designed. Problems to be addressed include: the extent, magnitude, and variability of the predicted depletion in F-region ionization together with descriptions of water and hydrogen injections into the atmosphere characteristic of SPS vehicles and flight profiles; the long-term variations in mesospheric humidity and cloudiness with and without SPS operations; and the description of condensation and evaporation processes of water exhausted from high-altitude rockets in order to predict mesospheric contrail formation and dissipation. Furthermore, in considering argon ion rocket transport to geosynchronous orbit, the stopping and lifetime of the argon ion beams and consequent changes in the radiation belts, especially as they affect spacecraft, should also be addressed.

38645 (DOE/ET/10040—4) **Terrestrial biosphere subcomponents on the global CO_2 balance. Problem definition and feasibility workshops. Final report.** Loucks, O.L. (Institute of Ecology, Indianapolis, IN (USA)). Apr 1980. Contract AC02-79EV10040. 8p. NTIS, PC A02/MF A01.

Analyses of temperate zone forests, poorly-drained organic soils and freshwater systems subject to nutrient enrichment were studied to determine their significance in the overall global carbon cycle. Of the systems considered, temperate zone forests make the largest contribution to the dynamic balance of the cycle, removing 2.7 to 3.3 times as much carbon from the atmospheric annually as either organic soils or aquatic sediments exchange. The results obtained are summarized; the papers and reports already completed and the several additional reports whose publication is pending are listed.

38646 (LA—8523-MS) **Future credible precipitation occurrences in Los Alamos, New Mexico.** Abeele, W.V. (Los Alamos Scientific Lab., NM (USA)). Sep 1980. Contract W-7405-ENG-36. 11p. NTIS, PC A02/MF A01.

I have studied many factors thought to have influenced past climatic change. Because they might recur, they are possible suspects for future climatic alterations. Most of these factors are totally unpredictable; therefore, they cast a shadow on the validity of derived climatic predictions. Changes in atmospheric conditions and in continental surfaces, variations in solar radiation, and in the earth's orbit around the sun are among the influential mechanisms investigated. Even when models are set up that include the above parameters, their reliability will depend on unpredictable variables totally alien to the model (like volcanic eruptions). Based on climatic records, however, maximum precipitation amounts have been calculated for different probability levels. These seem to correspond well to past precipitation occurrences, derived from tree ring indices. The link between tree ring indices and local climate has been established through regression analysis.

38647 (PB—80-805427) **Climatic changes from increased atmospheric carbon dioxide (citations from the NTIS data base). Report for 1970-Jan 1980.** Reimherr, G.W. (National Technical Information Service, Springfield, VA (USA)). Feb 1980. 46p. NTIS PC N01/MF N01.

The cited reports of Federally-funded research examine the relationship between climatic changes and an increase in atmospheric carbon dioxide. Topics considered include the Greenhouse effect, global climatic models, and climatic effects from increased combustion of fossil fuels. (Contains 39 abstracts)

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 37549, 38403, 38710, 38715, 38723, 38884

38648 (ANL/EES-TM—98) **Measurements of the particles and gases in the ground cloud from an Atlas/Centaur rocket.** Radke, L.F.; Eltgroth, M.W.; Hegg, D.A.; Hobbs, P.V. (Washington Univ., Seattle (USA). Dept. of Atmospheric Sciences). Feb 1979. Contract W-31-109-ENG-38. 73p. NTIS, PC A04/MF A01.

Fifty-two airborne penetrations were made of the concentrations of NO and NO_2. The rate of conversion of NO to NO_2 was limited by the rate at which ambient O_3 was mixed into the ground cloud. Methane concentrations in the ground cloud were similar to those in the ambient air, but up to 49 min after the launch the total non-methane hydrocarbon in the ground cloud was slightly higher than in the ambient air.The concentrations of particles in the ground cloud were particularly prominent around particle sizes of 5×10^{-3} μm and 0.1 μm. The larger particles were probably due to direct injection from the rocket and the smaller particles to gas-to-particle conversion in the plume. Within 25 min of the launch, most of the mass of the particles in the ground cloud were less than a few micrometers in size. The average of the particles was 1.1 g m^{-3}. The total mass of particles having diameters < 2 μm remained fairly constant after the initial sedimentation process for at least 70 min, but it was surprisingly small ($\sim$ 1 kg, or 0.012.2% of the propellant that was burned).

38649 (BNL—28348) **Size effects in aerosol particle interactions: the van der Waals potential and collision rates.** Marlow, W.H. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 16p. (CONF-800993—1). NTIS, PC A02/MF A01.

From 2. international conference on inorganic clusters and fine particles; Lausanne, Switzerland (8 Sep 1980).

Three effects which are explicitly dependent on aerosol particle size are identified and discussed. They are focussed about the particle collision rate and how it relates to the properties of the gas, the particle, and the particle's interaction potential energy which play roles in particle-particle collision rates. By incorporating the conduction electronic free path effect for conductors into the frequency-dependent dielectric constants of silver and graphite, particle size effects in the Lifshitz-van der Waals potentials for identical pairs of 1 nm and 100 nm particles are evaluated. Water and tetradecane particle interaction potentials for the same size particles are also calculated to illustrate size effects due to the retardation of the interaction. These potentials are then used to calculate the enhancement of the particle collision rates above their values in the absence of any potential at various gas pressures. The roles of the interaction potential in collision among identical pairs of particles of differing compositions is also briefly discussed.

38650 (BNL—51247) **MAP3S/RAINE modeling abstracts, 1980.** Michael, P. (ed.). (Argonne National Lab., IL (USA); Brookhaven National Lab., Upton, NY (USA); Battelle Pacific Northwest Labs., Richland, WA (USA)). Jul 1980. Contract AC02-76CH00016. 38p. NTIS, PC A03/MF A01.

The MultiState Atmospheric Power Production Pollution Study (MAP3S) has produced as a primary research output a number of numerical models for the calculation of airborne concentrations of sulfur dioxide and sulfate resulting from anthropogenic sources. Concise descriptions of these models, and of related modeling developments, are collected in this report. For each model, or model component, there is included a listing of the authors, a summary of what it is the model calculates and the method used, a list of references, and a statement of availability.

38651 (EPRI-EA—1466) **Chemical measurements in the Los Angeles atmosphere. Final report.** Brenner, S.; Brewer, R.L.; Kaplan, I.R.; Wong, W.W. (Global Geochemistry Corp., Canoga Park, CA (USA)). Jul 1980. 44p. NTIS, PC A03/MF A01.

An exploratory study was made of the Battelle Megavolume Sampler. This device collects gram quantities of aerosol particles from air at high flow rates, by impaction and electrostatic precipitation, in three ranges of particle size, namely 0-1.7 μm, 1.7-3.5 μm, and >3.5 μm. The usefulness of various sample treatments and analyses were examined. Samples were taken at the foothill location northeast of Los Angeles, where intense photochemical smog is often encountered. Samples were extracted into organic or aqueous solvents for chromatographic and spectroscopic treatments. Individual components were identified in the following classes: alkanes, fatty acids, dicarboxylic acids, carbonyl compounds, polynuclear aromatic hydrocarbons, inorganic anions, and metals. Elemental analyses for C, H, and N, $^{13}C/^{12}C$ ratios, electron spin resonance, and ^{14}C radio-activities were also run. The sampler was simple to operate and gave suitable samples, but quantitative recovery of material from the sampler was difficult. The distribution of certain homologous series of organic compounds, the high electron spin densities, and the finding from ^{14}C activities that only about 50% of the noncarbonate aerosol was fossil, all indicated that a substantial part of the aerosol was biogenic.

38652 (EPRI-EA—1516) **Biogenic sulfur emissions in the SURE region.** Adams, D.F.; Farwell, S.O.; Robinson, E.; Pack, M.R. (Washington State Univ., Pullman (USA)). Sep 1980. 170p. NTIS, PC A08/MF A01.

The objective of this study was to estimate the magnitude of biogenic sulfur emissions from the northeastern United States - defined as the EPRI Sulfate Regional Experiment (SURE) study area. Initial laboratory efforts developed and validated a portable sulfur sampling system and a sensitive, gas chromatographic analytical detection system. Twenty-one separate sites were visited in 1977 to obtain a representative sulfur emission sampling of soil orders, suborders, and wetlands. The procedure determined the quantity of sulfur added to sulfur-free sweep air by the soil flux as the clean air was blown through the dynamic enclosure set over the selected sampling area. This study represents the first systematic sampling for biogenic sulfur over such a wide range of soils and such a large land area. The major impacts upon the measured sulfur flux were found to include soil orders, temperature, sunlight intensity, tidal effects along coastal areas. A mathematical model was developed for biogenic sulfur emissions which related these field variables to the mean seasonal and annual ambient temperatures regimes for each SURE grid and the percentage of each soil order within each grid. This model showed that at least 53,500 metric tons (MT) of biogenic sulfur are emitted from the SURE land surfaces and approximately 10,000 MT are emitted from the oceanic fraction of the SURE grids. This equates to a land sulfur flux of nearly 0.02 gram of sulfur per square meter per yr, or about 0.6% of the reported anthropogenic emissions withn the SURE study area. Based upon these data and the summertime Bermuda high clockwise circulation of maritime air across Florida and the Gulf Coast states northward through the SURE area, the total land biogenic sulfur emission contribution to the SURE area atmospheric sulfur burden might approach 1 to 2.5% of the anthropogenic.

38653 (EPRI-EA—1538) **Development of an airborne lidar for characterizing particle distribution in the atmosphere. Final report.** Uthe, E.E.; Jimison, W.L.; Nielsen, N.B. (SRI International, Menlo Park, CA (USA). Atmospheric Science Center). Sep 1980. 45p. NTIS, PC A03/MF A01.

A two-wavelength (0.53 and 1.06 μm) airborne lidar system was constructed and field tested. The ALPHA-1 (Airborne Lidar Plume and Haze Analyzer) was designed to observe smoke plume and atmospheric boundary layer particles over large areas. A data-processing system was designed for both real-time facsimile (gray-scale) display and magnetic tape recording. Multiple microcomputers were used to optimize processing capabilities within the power, weight, and size constraints of medium-sized twin-engine aircraft. A one-week field program was conducted to evaluate ALPHA-1 performance and reliability. The system successfully observed boundary layer structure over the Los Angeles area and the downwind structure of particulate plumes from the Navajo (Page, Arizona) and Four Corners (Farmington, New Mexico) power plants. Except for one system failure, ALPHA-1 performed very well on its first data-collection mission. The data show the importance of terrain features in establishing particle distributions over urban areas and downwind of large power plants.

38654 (LA—8268-MS) **Sulfur dioxide emissions from primary nonferrous smelters in the Western United States.** Mangeng, C.; Mead, R. (Los Alamos Scientific Lab., NM (USA)). Aug 1980. Contract W-7405-ENG-36. 101p. NTIS, PC A06/MF A01.

The greatest source of sulfur dioxide emissions in the West has been the pyrometallurgical processing of copper, lead, and zinc ores. Until the early 1970s, the emissions from most nonferrous metal smelters were released without control into the environment. However, recent Federal and State legislation has mandated the need for large reductions of emissions, a task that will require the introduction of highly efficient sulfur dioxide control technology. The particular processes at each smelter, the smelter location, the capital and operating costs including the cost of energy, the resolution of currently litigated issues, and the metal market prices will be major influences on the choice of technology and on the schedule for implementation of smelter control plans. These parameters are examined, and the problems and issues associated with them are described. The future impact of smelter sulfur dioxide emissions is discussed within the framework of the relevant economic, technologial, and legal issues.

38655 (LA-UR—80-2485) **Statistical relationship between median visibility and conditions of worst-case manmade impact on visibility.** Gins, J.D.; Nochumson, D.; Trijonis, J. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 16p. (CONF-801114—1). NTIS, PC A02/MF A01.

From Symposium on plumes and visibility; Grand Canyon, AZ, USA (10 Nov 1980).

A study was conducted of the statistical relationships between median visibility and the levels of visibility associated with worst-case manmade impacts. The data base for the study consisted of midday visibility recordings for the years 1974-1976 at 28 suburban/nonurban airports throughout the United States. The visibility recordings were converted to estimates of extinction coefficients with the use of the Koschmeider formula. The data were sorted according to meteorology in order to eliminate days that were obviously dominated by natural causes of poor visibility. Three approaches were used for relating worst-case (90th through 99th percentile) extinction to median extinction. The first approach was based upon frequency distribution functions. The second used observed ratios of upper percentile to median extinction. The third employed regression techniques. All of the relationships were formulated and evaluated with the 1974-1976 data on a national/annual basis as well as regional/quarterly basis. Performance tests were also run against 1954-1956 data at 11 of the 28 sites. Simple ratio relationships are recommended for use in translating median visibility impacts into worst-case impacts. The errors associated with these ratio models are approximately 30%, which is less than the error typically associated with mathematical dispersion models.

38656 (LBL—10735) **Atmospheric aerosol research, FY 1979.** (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1980. Contract W-7405-ENG-48. 45p. NTIS, PC A03/MF A01.

Each of the twelve sections was abstracted and indexed for EDB/ERA. (JGB)

38657 (LBL—10735, pp 8.2-8.4) **Carbon-catalyzed reactions in aqueous suspensions: oxidation of SO_2 at low concentrations.** Brodzinsky, R. Jul 1980.

In Atmospheric aerosol research, FY 1979.

Research has been reported previously on the role of soot particles as catalysts for SO_2 oxidation by studying the effect of

liquid water on the carbon-catalyzed reaction. Current research is directed toward studying the effects that the concentration of S(IV) species have on the reaction rate. A reaction rate law and a proposed reaction mechanism for the catalytic suspension are presented. Results indicate that the reaction rate has a complex dependence on the concentration of H_2SO_3, ranging between a second and zeroth order reaction. (JGB)

38658 (LBL—10735, pp 8.4-8.6) **Reduction of NO/sub x/ in aqueous solution.** Oblath, S. Jul 1980.

In Atmospheric aerosol research, FY 1979.

Previous investigations of the reactions of NO/sub x/ in aqueous solutions revealed many competing reactions. Because the formation of hydroxylamine disulfonate (HADS) is the first step to any of the products when nitrous acid reacts with sulfurous acid under most atmospheric conditions, investigating the kinetics of HADS is essential to any attempt at assessing the importance of this system as a sink of NO/sub x/ and as a source of sulfate and reduced nitrogen species. Previous work determined the order of reaction with respect to nitrite, bisulfite, and hydrogen ion. Results of current research to determine the pH, temperature, and ionic strength dependencies of the reaction and a mass balance for nitrogen species are reported. (JGB)

38659 (LBL—10735, pp 8.7-8.10) **Sulfate formation by combustion particles in a laboratory fog chamber.** Benner, W. Jul 1980.

In Atmospheric aerosol research, FY 1979.

The description of the chemical and physical processes which introduce sulfate into the atmosphere is being revised constantly. Recent attention has been directed towards sulfate formation pathways which involve liquid water. The work reported here focusses on a pathway in which SO_2 is oxidized by dispersed water droplets such as those found in plumes, clouds, and fogs. Preliminary results indicate that water can condense onto soot particles and encapsulate them with a liquid layer. Depending on conditions, it is possible that not all the soot particles become encapsulated with water. The presence of soot in the soot-fog-SO_2 system is important for sulfate formation because experiments conducted with sootless flames produced little sulfate. In general, the amount of sulfate that formed in fog-soot-SO_2 reactions was dependent upon $[SO_2]$, because more sulfate formed at higher SO_2 concentrations.

38660 (LBL—10735, pp 8.10-8.13) **Lifetime of liquid water droplets: an experimental study of the role of surfactants.** Toossi, R. Jul 1980.

In Atmospheric aerosol research, FY 1979.

Experimental measurements of the lifetime of water droplets in the presence of various realistic organic impurities that are generated from combustion sources are reported. These results are compared to laboratory-generated fog samples and rain samples. From these measurements, the accommodation coefficients of the various samples are calculated. The measurements will be extended to atmospheric fog and cloud samples.

38661 (LBL—10735, pp 8.14-8.15) **Photoacoustic investigation of urban aerosol particles.** Yasa, Z. Jul 1980.

In Atmospheric aerosol research, FY 1979.

Recent studies using Raman spectroscopy and an optical attenuation technique indicate that the absorbing species in urban particulates is graphitic carbon. The results of a photoacoustic investigation that give an independent verification of this hypothesis are reported.

38662 (LBL—10735, pp 8.16-8.21) **Use of an optical attenuation technique to estimate the carbonaceous component of urban aerosols.** Hansen, A. Jul 1980.

In Atmospheric aerosol research, FY 1979.

Data are presented from a large-scale sampling program, and results showing that a measurement of the optical absorption of the particles may be used to quantitate the black carbon component of urban aerosols and to estimate the total carbon loading are given. There were substantial quantities of carbon present in the ambient aerosol at every sampling site studied. The fact that the black carbon accounts for an approximately constant fraction of the carbonaceous aerosol at all locations implies that the optical attenuation measurement may be used to estimate the total carbon content of an ambient sample. (JGB)

38663 (LBL—10735, pp 8.25-8.27) **Application of thermal analysis to the characterization of nitrogenous aerosol species.** Dod, R. Jul 1980.

In Atmospheric aerosol research, FY 1979.

In a previous report a combined optical attenuation-thermal analysis apparatus for the characterization of particulate carbonaceous aerosol material was described. The use of this apparatus was extended to include the simultaneous characterization of nitrogenous species. A schematic representation of the apparatus used in the analysis of carbonaceous material is shown. The actual measurement consists of monitoring the CO_2 concentration as a function of the sample temperature. The result is a thermogram, i.e., a plot of the CO_2 concentration vs temperature, with the area under the thermogram proportional to the carbon content of the sample. The capabilities of the thermal analysis method was expanded to nitrogenous species by connecting the outlet of the passive CO_2 analyzer through an orifice to a chemiluminescent NO/sub x/ analyzer. Although the method is still in the development stage, it was applied to several ambient particulate samples.

38664 (LBL—10735, pp 8.27-8.30) **Application of selective solvent extraction and thermal analysis to ambient and source-enriched aerosols.** Gundel, L. Jul 1980.

In Atmospheric aerosol research, FY 1979.

Selective solvent extraction (SSE) has been used previously to characterize carbonaceous aerosol particles by estimating the fractions of primary, secondary, and elemental carbon in ambient and source aerosols. This laboratory has recently developed a thermal analysis (TA) technique which allows simultaneous measurement of light transmission through a filter and evolved CO_2 during its temperature-programmed combustion. In this study these techniques were used in a complementary manner by performing TA on particulate samples which have been subjected to SSE. The samples chosen for this study were collected during the same sampling periods at two locations in Berkeley, California - one close to a freeway and the other closer to our laboratory. Results indicate that thermal analysis of extracted filters provides further characterization of carbonaceous particulates than can be achieved with either TA or SSE alone. It is now possible to determine the amounts of black carbon in particulate matter using combined selective solvent extraction and thermal analysis.

38665 (LBL—10735, pp 8.30-8.35) **Determination of carbon in atmospheric aerosols by deuteron-induced nuclear reactions.** Clemenson, M. Jul 1980.

In Atmospheric aerosol research, FY 1979.

Advantages and disadvantages of various destructive and nondestructive methods for the determination of carbon in atmospheric aerosols are discussed. The deuteron activation analysis takes advantage of favorable nuclear properties and cross sections. Carbon is detected by the use of deuterons to induce the $^{12}C(d,n)^{13}N$ reaction. The decay of the 10.0-min ^{13}N is followed by its 0.511-MeV annihilation radiation using γ spectrometry. The deuteron activation method was used to analyze nondestructive samples containing varying amounts of carbon. The samples were subsequently analyzed for carbon in two separate laboratories using destructive combustion methods. The results of these analyses are summarized. Comparison of the carbon found by deuteron activation analysis and that found by the independent combustion methods shows a standard deviation of 10% for the 15 samples that were analyzed. The agreement holds over a wide range of carbon contents from 0.6 to 268 $\mu g\ C/cm^2$. The agreement is good for both the laboratory-prepared samples and the ambient aerosol samples.

38666 (LBL—10735, pp 8.35-8.37) **Investigation of sampling artifacts in filtration collection of carbonaceous aerosol particles.** Dod, R. Jul 1980.

In Atmospheric aerosol research, FY 1979.

Carbon is a major fraction of the ambient atmospheric aerosol and is usually sampled by collecting particles on a filter. Questions have been raised as to how well the particles collected on a filter represent those actually present in the air. Speculations regarding sampling artifacts have included adsorption and desorption of carbonaceous compounds from the collected particles and filter material as well as chemical transformations which would affect the volatility of some compounds. A description is given of the application of optico-thermal combustion analysis, as well as total carbon combustion analysis, to samples collected on pre-fired quartz fiber filters in an effort to elucidate the magnitude of some of these effects. The results reported are consistent with those from preliminary experiments in both Berkeley and Anaheim using the filter pack technique, indicating that over a period of several days, the physical transfer of carbonaceous aerosol by liquid flow is not significant.

38667 (LBL—10735, pp 8.37-8.40) **Surface characterization of flyash.** Cohen, S. Jul 1980.

In Atmospheric aerosol research, FY 1979.

Electron spectroscopy for chemical analysis (ESCA) can be used as a nondestructive surface-speciation technique. Initial studies consisted of ESCA analysis of unleached flyash. Elements most strongly detected are Cu, Cr, Fe, Ba, Ca, Na, Al, As, C, Cl, O, P, S, and Si. Some information on chemical state was obtained; sulfur appears to be in the S(VI) form. The flyash was then leached by ultrasonic treatment. Compounds found in the leachate were compared with changes found on the flyash surface using ESCA. Although most of the initial leachate analyses were qualitative, some quantitative information was obtained. Ba^{2+} was detected at a concentration equal to the solubility limit of $BaSO_4$ in the H_2O leachate. This is precisely the result expected if the sparingly soluble salt $BaSO_4$ precipitates out of the wash. In every case examined, the

nitric acid was found to be a better extractant than H_2O. Inspection of flyash surfaces after sonication provided good correlation for some species.

38668 (LBL—10735, pp 8.22-8.24) **Identification of soot in urban atmospheres by an optical absorption technique.** Rosen, H. Jul 1980.

In Atmospheric aerosol research, FY 1979.

A description is given of the application of a new method of analysis that uses the unique optical properties of graphitic soot to trace the primary component of the carbonaceous particulates under widely different atmospheric conditions over a wide geographical area. The results are consistent with the earlier work of Novakov et al, and indicate that primary soot emissions compose a major fraction of the urban carbonaceous aerosol. There is a strong correlation ($r > 0.85$) between optical attenuation and total suspended particulate carbon at every site studied; the least squares fit of the data shows relatively small regional differences with a trend toward increasing slope (enrichment in primary carbonaceous matter) for samples collected respectively at Berkeley, Fremont, Anaheim, and Argonne; there is a strong correlation between the optical attenuation and the carbon loading for the source samples, and the slope of the least squares fit is comparable to that found in the ambient samples.

38669 (PB—80-122278) **Oxidant-precursor relationships. Final report.** Stephens, E.R.; Hellrich, O.P. (California Univ., Riverside (USA). Statewide Air Pollution Research Center). Aug 1979. 74p. NTIS, PC A04/MF A01.

New methods of ambient air analysis were used to define more clearly the relationships between oxidants and their precursors. Non-methane hydrocarbons, NOx, O2, and oxidants were measured at the same time and location (Riverside, California). The ambient air data presented in this report are displayed as a series of conditional joint distributions. The correlations range from excellent--ozone vs oxidant--to poor or bimodal--ozone with nonmethane-ethane organics (NMEO) or with NOx. The ratio of NMEO to NOx was always higher than indicated by inventories and showed a large scatter. No depletion of NMEO with respect to acetylene could be detected.

38670 (PB—80-122625) **Emission growth factors for the Niagara frontier. Final report.** (Erie and Niagara Counties Regional Planning Board, Grand Island, NY (USA)). Jul 1979. Contract EPA-68-02-2956. 148p. NTIS, PC A07/MF A01.

As part of the New York State Implementation Plan revision for the Niagara Frontier Air Quality Maintenance Area, the Erie and Niagara Counties Regional Planning Board has provided growth factors for the years 1982 and 1990, using 1975 as the base year for area sources and facilities within Erie and Niagara Counties which generate either sulphur dioxide or particulate matter. Growth factors for 23 area sources were developed for 316 grid cells within the Erie-Niagara Region. Growth factors were also developed for 63 industrial facilities within the Erie-Niagara Region. A description of each facility considered, and the methodology employed in projecting growth for each facility is detailed. Further, the potential for reliability of all growth factor projections within the report are discussed.

38671 (PB—80-122757) **Economic impact of requiring maintenance/malfunction plans for air pollution control equipment, R79-3. Final report.** (ITI Management Research Associates, Springfield, IL (USA)). Jun 1979. 104p. NTIS, PC A06/MF A01.

The report estimates and compares the benefits and costs of proposals that are intended to improve ambient air quality by increasing the operating efficiency of pollution control equipment and emission sources. Uncertainty associated with calculation of the benefits and the costs account for the wide range of values and make it essential that estimates of benefits and costs should be taken as an order of magnitude only.

38672 (PB—80-122815) **Survey of the role of Nox in nonurban ozone formation. Final report.** Martinez, J.R.; Singh, H.B. (SRI International, Menlo Park, CA (USA)). Sep 1979. Contract EPA-68-02-2835. 156p. NTIS, PC A08/MF A01.

This study surveys and summarizes current knowledge about the role of oxides of nitrogen (NOx) in the formation of ozone (O3) in nonurban areas. Project elements include a literature review, a survey of expert opinion, and analyses of field data. The results of the study show that present knowledge about NOx/O3 interactions in nonurban areas is fragmentary, and that there is no direct quantitative description of the link between urban NOx and nonurban O3. A preliminary analysis of nine rural and suburban sites indicates that transport is the principle mechanism associated with ozone levels that exceed 100 ppb. The analysis further suggests that transport times of the order of six to eight hours are most likely to be associated with the high ozone observed at these sites.

38673 (PB—80-123045) **Research for particulate control. EPA's mobile test vans.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Industrial Environmental Research Lab.). 1979. 18p. NTIS, PC A02/MF A01.

This report discusses EPA's mobile vans and their use in on-site aerosol monitoring. It contains a complete explanation of what is involved in hosting a mobile particulate control van at a plant, including specifications for installation and operation of the equipment.

38674 (PB—80-123516) **Power plant impacts on air quality and visibility: siting and emission control implications. Final report Nov 78-Aug 79.** Latimer, D.A. (Systems Applications, Inc., San Rafael, CA (USA)). 14 Aug 1979. Contract EPA-68-01-3947. 130p. NTIS, PC A07/MF A01.

The air quality and visibility impact of various sizes of power plants, which emit SO2 and NOx at various rates, was analyzed using analysis methods either recommended or likely to be accepted by the EPA. The impact of single power plant plumes and cumulative emissions on a regional scale were considered. Tentative conclusions are made regarding the air quality and visibility impacts of power plants individually and collectively throughout a region and the implications of these impacts for power plant sitings and emissions control.

38675 (PB—80-123557) **Evaluation of fugitive dust emissions from mining. Report on task 1 and 2.** (PEDCO-Environmental, Inc., Cincinnati, OH (USA)). Apr 1976. Contract EPA-68-02-1321. 141p. NTIS, PC A07/MF A01.

This evaluation of fugitive dust air pollution from mining operations was undertaken to identify and compile currently available information on emission sources, regulatory approaches, control techniques, and research programs related to mining activities. An analysis of the assembled information will then be used as the basis for recommending near-term research and development programs which might be implemented by IERL-Cincinnati to fill gaps in the data base and further document effective control techniques for fugitive dust from mining operations. For the more promising recommended R and D efforts, proposed technical approaches will also be developed. This project is composed of three tasks: Task (1) Identification of fugitive dust sources associated with mining activities; Task (2) Assessment of current status of the environmental aspects of fugitive dust; Task (3) Recommendation of promising research areas. Tasks 1 and 2 are presented in this report.

38676 (PB—80-124258) **Gridded annual pollutant emissions east of the Rocky Mountains.** Clark, T.L. (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab.). May 1979. 180p. NTIS, PC A09/MF A01.

Annual pollutant emissions of particulates, sulfur dioxide, nitrogen oxides, hydrocarbons, and carbon monoxide from point and area sources are apportioned to 80-km grid squares on a 35 by 30 grid network. The grid network is a polar stereographic projection true to 60 degrees N. The domain of the network includes southern Canada and much of the United States east of the Rocky Mountains. Southern Texas and northern New England are omitted. In addition, the emissions of the five pollutants are apportioned to 20-km grid squares on a 40 by 40 grid network, which is a subset of the previously mentioned grid network. The domain of the 40 by 40 grid network encompasses the area roughly from Columbus, Ohio to Portland, Maine and from Richmond Virginia to Ottawa, Ontario. The emission data were obtained from the 1977 Environmental Protection Agency National Emissions Data System (NEDS) file as well as from data compiled by the Ontario Ministry of the Environment and Environment Canada. These emission inventories, the design of the gridding procedures, and the major source classifications responsible for much of the emissions are discussed. The emission grids are presented in both figure and tabular forms.

38677 (PB—80-125099) **Studies in the review of the photochemical oxidant standard. Final report.** Biller, W.F. (Biller (William F.), East Brunswick, NJ (USA)). Jan 1979. Contract EPA-68-02-2589. 173p. NTIS, PC A08/MF A01.

Studies were performed in three areas for the Office of Air Quality Planning and Standards to support its review of the photochemical oxidants standard: (1) the desirability of changing from a photochemical oxidants to an ozone standard, (2) the suitability of alternate ways of expressing the standard and, (3) the assessment of health risks at alternate levels of the standard. From the first study it was concluded that a change to an ozone standard could lead to benefits in administering the standard with little or no loss in protection of the public health and welfare. The second study concluded that national ambient air standards should be expressed in a statistical form. A statistical form is more in accord with the actual behavior of pollutant concentrations in the atmosphere. In the third area the mathematical methodology was developed for estimating the risk that health effect thresholds for sensitive populations will be exceeded during a given period of time at alternate levels of the ambient air quality standard. The method quantitatively treats the

uncertainties in health effects thresholds and the extreme concentration levels of pollutant to be experienced in the given time period.

38678 (PB—80-128515) **Analysis of high sulfate concentrations in greater New York City air. Report for Dec 1978-Aug 1979.** DeMarrais, G.A.; Coventry, D.H. (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab.). Dec 1979. 43p. NTIS, PC A03/MF A01.

The meteorological phenomena occurring during April 15 to 21, 1976, when high sulfate concentrations were measured in the New York City area, are summarized. Findings of earlier investigations of relationships between meteorological phenomena and high sulfate concentrations are compared to the findings of this investigation. Since ozone readily occurs with the same meteorological conditions than are associated with sulfate episodes, the ozone concentrations are also discussed. Results showed that the current procedure for sampling sulfate every sixth day does not provide sufficient data for adequately determining how sulfate concentrations relate to meteorological phenomena. The sampling schedule only allows for indicating what the meteorological conditions were when the concentrations were a certain value and not how the concentrations changed with changing meteorological conditions.

38679 (PB—80-128812) **Source assessment: solvent evaporation - degreasing operations. Final report.** Hoogheem, T.J.; Horn, D.A.; Hughes, T.W.; Marn, P.J. (Monsanto Research Corp., Dayton, OH (USA)). Aug 1979. Contract EPA-68-02-1874. 133p. NTIS, PC A07/MF A01.

This report describes a study of air emissions from solvent degreasing and fabric scouring operations. This study was completed to provide EPA with sufficient information to determine whether additional control technology needs to be developed for these emission sources. Degreasing operations include: (1) cold cleaning; (2) open top vapor degreasing; (3) conveyorized vapor degreasing; and (4) fabric scouring. These four types consumed an estimated 943,000 metric tons of solvent in an estimated 1,255,000 operating locations in 1974. To assess the potential environmental effect of emissions (hydrocarbons) resulting from degreasing operations, the source severity (defined as the ratio of the time-averaged maximum ground level concentration of a pollutant to a potentially hazardous concentration) was calculated for each solvent emitted from each type of representative degreaser. Methylene chloride (2.2) and perchloroethylene (1.2) from conveyorized vapor degreasing had the two largest source severities. Solvent consumption for degreasing is expected to grow at an annual rate of 4% through 1980. If the 1980 level of emissions control is the same as the 1974 level, emissions from degreasing operations will increase by 26% over that period.

38680 (PB—80-131485) **Source assessment: analysis of uncertainty--principles and applications. Final report, Nov 1976-Mar 1978.** Serth, R.W.; Hughes, T.W.; Opferkuch, R.E.; Eimutis, E.C. (Monsanto Research Corp., Dayton, OH (USA)). Aug 1978. Contract EPA-68-02-1874. 181p. NTIS, PC A09/MF A01.

This report provides the results of a study that was conducted to analyze the uncertainties involved in the calculation of the decision parameters used in the Source Assessment Program and to determine the effect of these uncertainties on the decision-making procedure. A general procedure for performing an analysis of uncertainty is developed based on the principles of error propagation and statistical inference. It is shown that this simple and straightforward method represents an approximation to standard statistical techniques. The approximate method is illustrated by application to four problems in the area of environmental control. The general procedure is used to establish guidelines for conducting air emissions studies in the Source Assessment Program. In particular, guidelines are established for precision in field sampling and analytical work, and for setting critical values of decision parameters.

38681 (PB—80-132426) **Economic impact of implementing RACT (Reasonably Available Control Technology) guidelines in the nonattainment areas for ozone in North Carolina. Final report.** (Booz-Allen and Hamilton, Inc., Florham Park, NJ (USA). Foster D. Snell Div.). Mar 1979. Contract EPA-68-02-2544. 91p. NTIS, PC A05/MF A01.

The major objective of the contract effort was to determine the direct economic impact of implementing RACT standards in North Carolina. The study is to be used primarily to assist EPA and state decisions on achieving the emission limitations of the RACT standards. The economic impact was assessed for the following 2 RACT industrial categories: surface coating of paper and bulk gasoline terminals. Direct economic costs and benefits from the implementation of RACT limitations were identified and quantified while secondary impacts (social, energy, employment, etc.) are addressed, they were not a major emphasis in the study.

38682 (PB—80-132830) **Spatial variability of ozone and other pollutants at St. Louis, Missouri.** Karl, T.R. (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Sciences Research Lab.). Oct 1979. 42p. NTIS, PC A03/MF A01.

A network of 25 aerometric stations was part of the U.S. Environmental Protection Agency's Regional Air Pollution Study (RAPS) in the greater St. Louis area. At these stations ozone (O3) and various other photochemical pollutants (NO, NO2, and total hydrocarbons (THC3)) as well as carbon monoxide (CO) were analyzed with respect to their spatial variability. Data were analyzed for the warm months of the year, April thru October of 1975 and 1976--periods during which high O3 concentrations are common. The results of these analyses indicate that when O3 concentrations are high (above 100 ppb) the daily 1-h maximum O3 concentration is highly dependent upon the location of measurement. Measurements made at these times in both urban and rural locations in and around St. Louis were frequently found to vary by a factor of two and occasionally by a factor as large as four. Simultaneous hourly average measurements for each of the pollutants were correlated across the network of 25 stations. Rather poor correlations were found for the primary pollutants such as CO, NO, NO2, and THC. Analyses of normalized fields of pollutant concentrations suggest that the scavenging of O3 by NO dominates the O3-NOx reaction cycle before 1000 CDT.

38683 (PB—80-133036) **Industrial Source Complex (ISC) dispersion model. Software.** Schewe, G.; Sieurin, E. (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Jan 1980. mag tap. Source tape is in EBCDIC character set. Tapes can be prepared in most standard 7 or 9 track recording modes for one-half inch tape. Identify recording mode desired by specifying character set, track, density and parity. Call NTIS Computer Products if you have questions. Price includes documentation, PB80-133044, and PB80-133051.

The model updates various EPA dispersion model algorithms and combines them in two computer programs that can be used to assess the air quality impact of emissions from the wide variety of source types associated with an industrial source complex. The ISC Model short-term program ISCST, an updated version of the EPA Single Source (CRSTER) Model uses sequential hourly meteorological data to calculate values of average concentration or total dry deposition for time periods of 1, 2, 3, 4, 6, 8, 12 and 24 hours. Additionally, ISCST may be used to calculate 'N' is 366 days. The ISC Model long-term computer program ISCLT, a sector-averaged model that updates and combines basic features of the EPA Air Quality Display Model (AQDM) and the EPA Climatological Dispersion Model (CDM), uses STAR Summaries to calculate seasonal and/or annual average concentration or total deposition values. Both the ISCST and ISCLT programs make the same basic dispersion-model assumptions. Additionally, both the ISCST and ISCLT programs use either a polar or a Cartesian receptor grid...Software Description: The programs are written in the FORTRAN IV programming language for implementation on a UNIVAC 1110 computer and also on medium-to-large IBM or CDC systems. 65,000k words of core storage are required to operate the model.

38684 (PB—80-133044) **Industrial Source Complex (ISC) dispersion model user's guide. volume I. Final report.** Bowers, J.F.; Bjorklund, J.R.; Cheney, C.S. (Cramer (H.E.) Co., Inc., Salt Lake City, UT (USA)). Dec 1979. Contract EPA-68-02-3323. 367p. NTIS, PC A16/MF A01.

Volume I describes the Industrial Source Complex Dispersion Model and its use. The model updates various EPA dispersion model algorithms and combines them in two computer programs that can be used to assess the air quality impact of emissions from the wide variety of source types associated with an industrial source complex. The ISC Model short-term program ISCST, an updated version of the CRSTER, uses sequential hourly meteorological data to calculate values of average concentration or total dry deposition for time periods of 1, 2, 3, 4, 6, 8, 12 and 24 hours. Additionally, ISCST may be used to calculate 'N' is 366 days. The ISC Model long-term computer program ISCLT, a sector-averaged model that updates and combines basic features of the Air Quality Display Model AQDM and the Climatological Dispersion Model CDM, uses STAR summaries to calculate seasonal and/or annual average concentration or total deposition values. The ISC Model programs are written in Fortran IV for the Univac 1110 computer. The two programs may also be used on medium-to-large IBM or CDC computer systems with little or no modification.

38685 (PB—80-133051) **Industrial Source Complex (ISC) dispersion model user's guide. volume II: appendices a through i. Final report.** Bowers, J.F.; Bjorklund, J.R.; Cheney, C.S. (Cramer (H.E.) Co., Inc., Salt Lake City, UT (USA)). Dec 1979. Contract EPA-68-02-3323. 470p. NTIS, PC A20/MF A01.

Volume II contains the computer source code for the short term and long term Industrial Source Complex Dispersion models. The source code for the Meteorological Preprocessor program is also included. Example input and output test results for each model and preprocessor are listed. Input coding forms for each model are included.

38686 (PB—80-133838) **SAROAD (Storage and Retrieval of Aerometric Data) information. Final report.** Summers, J.G. (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Feb 1979. 71p. NTIS, PC A04/MF A01.

This booklet describes the SAROAD system for an individual who is unfamiliar with SAROAD. The information booklet includes: (1) an overview of the data contained in SAROAD, (2) an explanation of available air quality publications, (3) a description of procedures for requesting data, and (4) a description and example of the most important computerized reports.

38687 (PB—80-134455) **A method of determining carbon monoxide concentrations using families of curves based on caline 2. Final report.** Treadway, A.; Bryan, J.M.; Carwile, B.G.; Ledyard, L. (Alabama State Highway Dept., Montgomery (USA)). Dec 1978. 26p. NTIS, PC A03/MF A01.

This study is intended to provide a method by which 'desktop' estimates of carbon monoxide (CO) concentrations can be determined using a minimum of calculations. In conjunction with 'Tabulations of Selected Low-Altitude Vehicle Emission Factors Based on EPA's Mobile Source Emission Factors Dated March 1978', dated September 1978, a 'first pass' CO analysis can be done in a matter of minutes.

38688 (PB—80-134950) **Long-range transport and transformation of SO_2 and sulfate. Final report may 77-apr 79.** Henmi, T.; Reiter, E.R. (Colorado State Univ., Fort Collins (USA). Dept. of Atmospheric Science). Nov 1979. 185p. NTIS, PC A09/MF A01.

Technical descriptions and computer programs are presented for two models that calculate long-range transport, diffusion, transformation of SO2 to sulfate, and dry and precipitation deposition of initially emitted SO2. One model treats the mixing layer height as constant; the other (at the expense of computer time) varies the mixing layer height diurnally and tracks pollutants in three layers--the daytime mixing layer, the nocturnal ground-based stable layer, and the daytime mixed layer that remains above the nocturnal stable layer. Application of the multi-layer model over a region encompassing the Ohio River Basin produced patterns of SO2 and sulfate concentrations that are statistically correlated with observed concentrations. An empirical formula for the transformation rate of SO2 to sulfate is derived. Using a cumulus cloud model, results showed that sulfate aerosol capture by cloud water through microphysical processes is sufficient to produce observed levels of sulfate in rain water.

38689 (PB—80-139041) **Characterization of visibility-reducing aerosols in the Southwest. Project Vistta. Progress report No. 1. Final report.** Macias, E.S.; Blumenthal, D.L.; Anderson, J.A.; Cantrell, B.K. (Meteorology Research, Inc., Altadena, CA (USA)). Nov 1979. Contract EPA-68-02-2713. 68p. NTIS, PC A04/MF A01.

The atmospheric visibility-reducing aerosol in the Southwest has been experimentally characterized with respect to particle size, composition, and contribution to light scattering. Measurements were taken within the mixing layer using the MRI instrumented Beechcraft Queen Air aircraft. The aircraft was equipped to measure and record on magnetic tape the light-scattering coefficient, Aitken nuclei count, size distribution, ozone, sulfur dioxide, nitrogen oxides, temperature, dew point, turbulence, pressure (altitude), and navigational parameters. Multistage impactor and size-fractionated filter samples were also collected in order to determine aerosol elemental composition as a function of size. Visual range estimates were obtained by viewing distant landmarks and verified by optical photography.

38690 (PB—80-804487) **Air pollution tracer studies in the lower atmosphere (citations from the NTIS data base). Report for 1964-Jan 80.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Feb 1980. 204p. NTIS PC N01/MF N01.

The cited reports cover research on the use of tracers to study lower atmospheric air pollution movements. The tracer used include sulfur hexafluoride, krypton 85, carbon 14, and other radioactive isotopes. The studies cite the results and techniques used, tracer movement from nuclear power plants, industrial stacks, urban areas, and the detectors used in their measurement. (This updated bibliography contains 197 abstracts, 31 of which are new entries to the previous edition.)

38691 (PB—80-804677) **The chemistry and physics of ozone in the stratosphere and upper atmosphere. Volume 2, 1977-January, 1980 (citations from the ntis data base). Report for 1977-jan 80.** Cavagnaro, D.M. (National Technical Information Service, Springfield, VA (USA)). Feb 1980. 215p. NTIS PC N01/MF N01.

The bibliography contains selected abstracts of research reports concerning chemical reactions and kinetics, particle physics, photochemistry, transport processes, and atmospheric models of ozone in the stratosphere. Analysis and sounding procedures and data are excluded. Effects of supersonic transport aircraft exhaust on ozone concentrations are included. (This updated bibliography contains 208 abstracts, 59 of which are new entries to the previous edition.)

38692 (SAND—80-2175C) **Lagrangian measurements of sulfur dioxide to sulfate conversion rates.** Zak, B.D. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 27p. (CONF-801114—4). NTIS, PC A03/MF A01.

From Symposium on plumes and visibility; Grand Canyon, AZ, USA (10 Nov 1980).

On the basis of Project MISTT data and proposed homogeneous gas phase oxidation mechanisms for sulfur dioxide, it has been suggested that the degree of mixing with background air, the chemical composition of the background air, and the intensity of the sunlight available are key factors determining the rate of sulfur dioxide to sulfate conversion. These hypotheses are examined in light of Lagrangian measurements of conversion rates in power plant plumes made during the Tennessee Plume Study and Project Da Vinci. It is found that the Lagrangian conversion rate measurements are consistent with these hypotheses. It has also been suggested that the concentration of ozone may serve as a workable surrogate for the concentrations of the free radicals involved in the homogeneous gas phase mechanism. Certain of the Lagrangian data indicate that this suggestion should be regarded with caution.

38693 (UCRL—52000-80-9) **Energy and Technology Review.** (California Univ., Livermore (USA). Lawrence Livermore National Lab.). Sep 1980. Contract W-7405-ENG-48. 46p. NTIS, PC A03/MF A01.

Seven articles were abstracted and indexed individually for EDB/ERA/GAP. (JGB)

38694 (UCRL—52000-80-9, pp 15-19) **Coal fly-ash studies.** Sep 1980.

In Energy and Technology Review.

Potentially hazardous emissions from coal-fired power plants are being studied. Fine particles are of special concern because certain toxic substances tend to collect on them, they stay in the air for long periods of time and travel long distances, and when inhaled they go deep into the lungs. This study was conducted in two phases, the first directed at conventional technology and the second at advanced combustion and control concepts (e.g., coal-oil mixtures and air-supported fluidized beds). The form of emitted particles and size distributions are being evaluated, and comprehensive trace-element, heavy-metal, radionuclide, and trace organic analyses of size-fractionated aerosol particles are being conducted. The composition and properties of coal fly-ash particles, particularly those smaller than 8 μm (i.e., those most likely to become lodged in the lung) were measured, and the mechanisms by which potentially harmful concentrations of toxic metals and mutagens condense upon them were investigated. Particle-size distributions were measured both at the smokestack and tens of kilometres downwind, and a three-dimensional computer model that accurately describes such dynamic aerosol processes as coagulation and sedimentation was developed.

38695 (UCRL—52000-80-9, pp 36-41) **Portable instrumentation for environmental field studies.** Sep 1980.

In Energy and Technology Review.

Environmental theories based on laboratory experiments must be confirmed by accurate measurments in the field. However, field conditions (heat, cold, dust, fog, rain, mud, and isolation from roads and power sources) pose serious problems for the instrument designer. In the past, researchers have had either to transport bulky equipment and powerful generators to the field or compromise on the quality of the data collected (and hence on its applicability). Recent innovations have aided in the design of a family of low-power, portable field instruments that make possible accurate measurements of plant gas-exchange rates, aggregate carbon uptake by tropical forests, and hydrocarbon concentrations from LNG spills.

38696 (UCRL—84069) **Determination of total ozone from DMSP multichannel filter radiometer measurements.** Luther, F.M.; Weichel, R.L. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). Sep 1980. Contract W-7405-ENG-48. 9p. (CONF-800869—2). NTIS, PC A02/MF A01.

From Quadrennial international ozone symposium; Boulder, CO, USA (4 Aug 1980).

The multichannel filter radiometer (MFR) infrared sensor was first flown in 1977 on a Defense Meteorological Satellite Program (DMSP) Block 5D series satellite operated by the US Air Force. The first four satellites in this series carried MFR sensors from which total atmospheric column ozone amounts may be derived. The last MFR sensor ceased operating on February 16, 1980. The series of four sensors spans a data period of nearly three years. The MFR sensor measures infrared radiances for 16 channels. Total ozone amounts are determined from sets of radiance measurements using an empirical relationship that is developed using linear regression analysis. Total ozone is modeled as a linear combination of terms involving functions of the MFR radiances for four channels (1,

3, 7 and 16) and the secant of the zenith angle. The ozone retrieval methodology is described schematically. The ozone retrieval model is developed through regression analysis using sets of simulated MFR radiances derived from detailed radiative transfer calculations. The MFR total ozone data are compared with independent ground-based Dobson measurements in order to evaluate the ozone retrieval methodology. Many Dobson observatories have been providing their daily measurements of total ozone which are taken close in time to DMSP overpass times. MFR total ozone data are compared with Dobson measurements taken between January 1 and February 15, 1979, and the results are summarized. Comparisons were made where the MFR and Dobson measurements are within 300 km and 300 minutes of each other. Percentages are computed with respect to the Dobson values. The MFR data were processed using a preliminary methodology, and the data will be reprocessed in the near future.

38697 Acid rain. Sweet, W. *Ed. Res. Rep. (Wash., D.C.);* **1**: No. 23, 447-464(20 Jun 1980).

Acid precipitation includes not only rain but also acidified snow, hail and frost, as well as sulfur and nitrogen dust. The principal source of acid precipitation is pollution emitted by power plants and smelters. Sulfur and nitrogen compounds contained in the emissions combine with moisture to form droplets with a high acid content - sometimes as acidic as vinegar. When sufficiently concentrated, these acids can kill fish and damage material structures. Under certain circumstances they may reduce crop and forest yields and cause or aggravate respiratory diseases in humans. During the summer, especially, pollutants tend to collect over the Great Lakes in high pressure systems. Since winds typically are westerly and rotate clockwise around high pressure systems, the pollutants gradually are dispersed throughout the eastern part of the continent.

38698 Air pollution analysis used in operating an environmental control unit. Edgar, R.T.; Fenyves, E.J.; Rea, W.J. (Univ. of Texas, Dallas). *Ann. Allergy;* **42**: No. 3, 166-173(Mar 1979).

A simple, fast and reliable method was developed to measure the origin and daily and seasonal variations of selected air pollutants in the Brookhaven Environmental Unit. None of the pollutants that were measured surpassed its threshold limit value. The average concentrations of the pollutants that were measured could be considered as preliminary standard for environmental units in hospitals as long as material analysis for outgassing is used simultaneously.

38699 Light-induced $Mg^{2}+$ ATPase activity of coupling factor intact chloroplasts. Mills, J.D.; Hind, G. (Brookhaven National Lab., Upton, NY). *Biochim. Biophys. Acta;* **547**: 455-462(1979).

Intense illumination of isolated, intact, spinach chloroplasts triggers the well known proton-pumping $Mg^{2}+$ ATPase activity of coupling factor, which can be assayed in subsequently lysed chloroplasts by monitoring ATP-driven quenching of 9-aminoacridine fluorescence. The light-triggered ATPase activity decays slowly in the dark and is inhibited by N,N'-dicyclohexylcarbodiimide. After osmotic lysis and washing of the chloroplasts, preillumination no longer triggers maximal proton-pumping ATPase until methylviologen and dithiothreitol are added to the medium. It is suggested that intact organelles contain soluble or loosely bound cofactors necessary for light-triggering of coupling factor ATPase. On osmotic lysis, these endogenous cofactors are diluted or inactivated and must be replaced by addition of a dithiol reagent and an electron acceptor.

38700 Electron transport pathways in spinach chloroplasts. Reduction of the primary acceptor of photosystem II by reduced nicotinamide adenine dinucleotide phosphate in the dark. Mills, J.D.; Crowther, D.; Slovacek, R.E.; Hind, G.; McCarty, R.E. (Brookhaven Natl. Lab., Upton, NY). *Biochim. Biophys. Acta;* **547**: 127-137(1979).

Addition of NADPH to osmotically lysed spinach chloroplasts results in a reduction of the primary acceptor (Q) of Photosystem II. This reduction of Q reaches a maximum of 50% in chloroplasts maintained under weak illumination and requires added ferredoxin and Mg^{2+}. The reaction is inhibited by (i) an antibody to ferredoxin-$NADP^{+}$ reductase (EC 1.6.7.1), (ii) treatment of chloroplasts with N-ethylmaleimide in the presence of NADPH, (iii) disulfodisalicylidenepropanediamine, (iv) antimycin, and (v) acceptors of non-cyclic electron transport. Uncouplers of phosphorylation do not affect NADPH-driven reduction of Q. It is proposed that electron flow from NADPH to Q may occur in the dark by a pathway utilising portions of the normal cyclic and non-cyclic electron carrier sequences. The possible in vivo role for such a pathway in redox poising of cyclic electron transport and hence in controlling the ATP/NADPH supply ratio is discussed.

38701 Composite hazard index for assessing limiting exposures to environmental pollutants: application through a case study. Rupp, E.M.; Parzyck, D.C.; Walsh, P.J.; Booth, R.S.; Raridon, R.J.; Whitfield, B.L. (Oak Ridge National Lab., TN). *Environ. Sci. Technol.;* **12**: 802-807(Jul 1978).

Application of the composite hazard index assessment methodology to cadmium release from a smelter complex in Montana has been used to illustrate the usefulness of the approach. The methodology can be applied to other sites and other pollutants in a similar manner by developing site specific information for parameters of the transport models incorporated into the methodology. When sufficient information is not available, the structure of the methodology provides guidance on needed information so that expenses for a particular study can be minimized. The composite hazard assessment methodology described can be developed to provide a comprehensive approach for the development of standards. 4 figures, 6 tables.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 38517, 38841

38702 (CONF-801038—3) **Index to the AEC/ERDA/DOE Air Cleaning Conferences.** Burchsted, C.A. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 6p. NTIS, PC A02/MF A01.

From 16. DOE nuclear air cleaning conference; San Diego, CA, USA (20 Oct 1980).

A comprehensive index to the papers in the second through sixteenth AEC/ERDA/DOE Nuclear Air Cleaning Conference is discussed. The index will be published in early 1981 and will be designated as Volume 3 of the proceeding of the sixteenth conference. The index has three parts, a straight numeric tabulation, an author index, and a key word in context (KWIC) index. (JGB)

38703 (DP—1552) **Computer code to assess accidental pollutant releases.** Pendergast, M.M.; Huang, J.C. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Jul 1980. Contract AC09-76SR00001. 22p. NTIS, PC A02/MF A01.

A computer code was developed to calculate the cumulative frequency distributions of relative concentrations of an air pollutant following an accidental release from a stack or from a building penetration such as a vent. The calculations of relative concentration are based on the Gaussian plume equations. The meteorological data used for the calculation are in the form of joint frequency distributions of wind and atmospheric stability.

38704 (DP—1566) **Calculation of particulate dispersion in a design-basis tornadic storm from the Atomics International Nuclear Material Development Facility, Santa Susana, California.** Pepper, D.W. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Jul 1980. Contract AC09-76SR00001. 28p. NTIS, PC A03/MF A01.

A three-dimensional numerical model is used to calculate ground-level air concentration and deposition (due to precipitation scavenging) after a hypothetical tornado strike at the Atomics International Nuclear Material Development Facility at Santa Susana, California. Plutonium particles less than 20 μm in diameter are assumed to be lifted into the tornadic storm cell by the vortex. The rotational characteristics of the tornadic storm are embedded within the larger mesoscale flow of the storm system. The design-basis translational wind values are based on probabilities associated with existing records of tornado strikes in the vicinity of the plant site. Turbulence exchange coefficients are based on empirical values deduced from experimental data in severe storms and from theoretical assumptions obtained from the literature. The method of moments is used to incorporate subgrid-scale resolution of the concentration within a grid cell volume. This method is a quasi-Lagrangian scheme which minimizes numerical error associated with advection. In all case studies, the effects of updrafts and downdrafts, coupled with scavenging of the particulates by precipitation, account for most of the material being deposited within 50 km downwind of the plant site. Ground-level isopleths in the x-y plane show that most of the material is deposited behind and slightly to the left of the centerline trajectory of the storm. Approximately 5% of the material is dispersed into the stratosphere and anvil section of the storm.

38705 (ORNL—5663) **Industrial safety and applied health physics. Annual report, 1979.** (Oak Ridge National Lab., TN (USA)). Sep 1980. Contract W-7405-ENG-26. 120p. NTIS, PC A06/MF A01.

In connection with personnel monitoring, there were no external or internal exposures to personnel which exceeded the standards for radiation protection as defined in DOE Manual Chapter 0524. Only 55 employees received whole-body dose equivalent of one rem or greater. The highest whole-body dose equivalent to an employee was 2.8 rem. The highest internal exposure was less than one-half of a maximum permissible dose for any calendar quarter. During 1979, 57 portable health physics instruments were added to the inventory and 75 retired. The total number in service on January 1, 1979, was 977. With regards to environmental monitoring, there were no releases of gaseous waste from the Laboratory which were

of a level that required an incident report to DOE. There were no releases of liquid radioactive waste from the Laboratory which were of a level that required an incident report to DOE. Soil samples were collected at all perimeter and remote monitoring stations and analyzed for eleven radionuclides including plutonium and uranium. Plutonium-239 content ranged from 0.01 to 0.06 pCi/g, and the uranium-235 content ranged from 0.01 to 0.05 pCi/g. Grass samples were collected at all perimeter and remote monitoring stations and analyzed for twelve radionuclides including plutonium and uranium. Plutonium-239 content ranged from 0.001 to 0.010 pCi/g, and uranium-235 content ranged from 0.001 to 0.010 pCi/g. Two radiation incidents involving radioactive materials were recorded during 1979. This compares with 14 incidents in 1978. (ERB)

38706 (PNL—3284) **Environmental status of the Hanford site for CY 1979.** Houston, J.R.; Blumer, P.J. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Aug 1980. Contract AC06-76RL01830. 80p. NTIS, PC A05/MF A01.

The Hanford environmental surveillance program provides for the measurement, interpretation, and evaluation of the radiological impact of Hanford operations on its onsite and offsite environs. The program is designed to evaluate all significant potential pathways for the release of radioactivity, especially those that may result in direct exposure of the public and those in which environmental reconcentration of radionuclides is likely to occur. Presented in this report are the results of effluent and environmental monitoring and sampling conducted to determine the onsite impact of ongoing operations.

38707 (UCRL—50025-80-1, pp 26-29) **Sensitive measurement system determines the concentration of transuranics and other long-lived alpha emitters in air.** 1 Apr 1980.

In Electronics Engineering Department. Quarterly report No. 1, 1980.

Research is underway on improving the sensitivity and response time of the monitoring systems used by nuclear facilities for determining the concentration of transuranics and other long-lived alpha emitters in the air exhausted through their stacks. A very sensitive alpha measurement system has been developed and fielded. It was tested at the plutonium finishing facilities of the Rockwell Hanford Operation and found to be at least 100 times more sensitive than presently available monitors.

38708 (UCRL—52959) **Utilization of the atmospheric release advisory capability (ARAC) services during and after the Three Mile Island accident.** Knox, J.B.; Dickerson, M.H.; Greenly, G.D.; Gudiksen, P.H.; Sullivan, T.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Jul 1980. Contract W-7405-ENG-48. 37p. NTIS, PC A03/MF A01.

At 0820 PST on 28 March 1979, the Department of Energy's Emergency Operations Center advised the Atmospheric Release Advisory Capability (ARAC) that the Three Mile Island nuclear power plant in Harrisburg, Pennsylvania, had experienced an accident some four hours earlier, resulting in the atmospheric release of xenon-133 and krypton-88. This report describes ARAC's response to the Three Mile Island accident, including the role ARAC played throughout the 20 days that real-time assessments were made available to the Department of Energy on-scene commander. It also describes the follow-up population-dose calculations performed for the President's Commission on Three Mile Island. At the request of the Nuclear Regulatory Commission, a questionnaire addressing the usefulness of ARAC products during the accident was sent to ARAC-product users. A summary of the findings from this questionnaire, along with recommendations for improving ARAC service, is also presented. The accident at Mississauga, Ontario, Canada, is discussed in the context of a well-planned emergency response by local and Federal officials.

REGULATIONS

REFER ALSO TO CITATION(S) 37514

38709 (EPA—600/7-79-167a, pp 386-417) **TVA compliance programs for SO_2 emission.** Hollinden, G.A.; Massey, C.L. (Tennessee Valley Authority, Chattanooga, TN). Jul 1979.

From 5. flue gas desulfurization symposium; Las Vegas, NV, USA (5 Mar 1979).

On April 19, 1976, a United States Supreme Court ruling favored mandatory constant SO_2 control requirements. Since that time, TVA has been implementing a billion dollar program to bring its power plants into compliance with State and Federal sulfur dioxide emission requirements. A consent decree was approved by the TVA Board of Directors on December 14, 1978, which will become effective upon approval by the Court. This paper will discuss the implementation of the compliance program at the TVA plants where flue gas desulfurization (FGD) will be used - Widow's Creek, Paradise, Johnsonville, and Cumberland Steam Plants. Results associated with the Widow's Creek unit 8 wet limestone scrubbing system will be presented. Coal washing, magnesium oxide scrubbing, and other innovative FGD processes will also be discussed.

ENVIRONMENTAL SCIENCES, TERRESTRIAL

BASIC STUDIES

REFER ALSO TO CITATION(S) 37980, 37981

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 37549, 38652, 38701, 38715

38710 **Compartmentalization of ^{14}C-DDT in an experimental old-field plot.** Grau, B.L.; Peterle, T.J. (Ohio State Univ., Columbus). *Bull. Environ. Contam. Toxicol.;* **22**: 846-853(1979).

In 1969, a study was initiated to trace the accumulation and translocation of chlorine-36 ring-labeled DDT in an intact old-field ecosystem. In that study, the accumulation of the pesticide in old-field flora and fauna was measured. Sufficient measurements of DDT in air, water, and soil for the immediate post application period were not obtaned in that study. A computer model of DDT movement in an old-field ecosystem was the final goal, DDT movement in the air, water, soil therefore had to be considered. This movement has been recorded for agricultural lands, including orchards, forest and aquatic systems but not for old-field ecosystems. Our objectives were to determine the rate of vaporization and translocation of ^{14}C-DDT into the air, surface run-off, ground water, and soil of an old-field experimental plot. Major plant species included grasses (Agropyron; Dactylis; Phleum; Poa); umbells (Daucus; Pastinaca) and composites (Achillea; Aster; Cirsium; Solidago).

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

SOIL

REFER ALSO TO CITATION(S) 37709, 37746

38711 (DOE/EV—0097) **Background report for the formerly utilized Manhattan Engineer District/Atomic Energy Commission sites program.** (Department of Energy, Washington, DC (USA). Office of Environmental Compliance and Overview). Sep 1980. 201p. NTIS, PC A10/MF A01.

The Department of Energy is conducting a program to determine radiological conditions at sites formerly used by the Army Corps of Engineers' Manhattan Engineer District and the Atomic Energy Commission in the early years of nuclear energy development. Also included in the program are sites used in the Los Alamos plutonium development program and the Trinity atomic bomb test site. Materials, equipment, buildings, and land became contaminated, primarily with naturally occurring radioactive nuclides. They were later decontaminated in accordance with the standards and survey methods in use at that time. Since then, however, radiological criteria, and proposed guidelines for release of such sites for unrestricted use have become more stringent as research on the effects of low-level radiation has progressed. In addition, records documenting some of these decontamination efforts cannot be found, and the final radiological conditions of the sites could not be adequately determined from the records. As a result, the Formerly Utilized Sites Program was initiated in 1974 to identify these formerly used sites and to reevaluate their radiological status. This report covers efforts through June 1980 to determine the radiological status of sites for which the existing conditions could not be clearly defined. Principal contractor facilities and associated properties have already been identified and activities are continuing to identify additional sites. Any new sites located will probably be subcontractor facilities and areas used for disposal of contractor waste or equipment; however, only limited information regarding this equipment and material has been collected to date. As additional information becomes available, supplemental reports will be published.

38712 (ORNL—5462) **Radiological survey of the inactive uranium-mill tailings at Falls City, Texas.** Haywood, F.F.; Christian, D.J.; Loy, E.T.; Lorenzo, D.; Ellis, B.S. (Oak Ridge National Lab., TN (USA)). Oct 1980. Contract W-7405-ENG-26. 75p. NTIS, PC A04/MF A01.

Results of a radiological survey conducted at the Falls City, Texas, site in July 1976 are presented. There are seven partial to fully stabilized tailings piles, and an overburden pile from an open-pit mine. Above ground gamma-ray exposure rate measurements show moderate levels of contamination throughout the area with a maximum exposure rate of 500 μR/hr above tailings pile 2. The average exposure rate over the different areas varied from 14 μR/hr over the southwest end of tailings pile 7 to 207 μR/hr over the northeast end of the same pile. Analyses of surface soil and dry-wash sediment samples, as well as calculations of subsurface ^{226}Ra distribution, serve to define the spread of tailings around the area. Water erosion of the tailings is evident, but, because of abundant growth of vegetation on the tailings piles, wind erosion probably is not a major problem.

38713 (ORNL/TM—7386) **Sampling of technetium-99 in vegetation and soils in the vicinity of operating gaseous facilities. Environmental Sciences Division Publication No. 1550.** Hoffman, F.O.; Huckabee, J.W.; Lucas, D.M.; Garten, C.T. Jr.; Scott, T.G.; Walker, R.L.; Gouge, P.S.; Holmes, C.V. (Oak Ridge National Lab., TN (USA)). Oct 1980. Contract W-7405-ENG-26. 60p. NTIS, PC A04/MF A01.

Technetium-99 was measured in vegetation and soils collected near three operating gaseous diffusion facilities to obtain estimates of the soil-to-vegetation concentration factor. Analyses were performed primarily using radiochemical separations and low-level beta counting techniques with selected samples checked by isotope dilution mass spectroscopy. The concentration factor pooled from all three facilities appeared to be lognormally distributed with a geometric mean of 9.5 and a geometric standard deviation of 2.4. These values are comparable to calculated equilibrium concentration factors derived from other field experiments in which concentrations in soil and vegetation were observed to decrease with time subsequent to a single application of/sup 95m/TcO_4^-. These field values are one to two orders of magnitude less than concentration factors derived from laboratory experiments using potted plants. It is suggested that the radiologic significance of ^{99}Tc in terrestrial food chains of importance to humans may be substantially lower than indicated by the simple difference between laboratory and field concentration factors if the time dependence of technetium activity in vegetation and soil is taken into consideration in radiological assessment models.

TERRESTRIAL ECOSYSTEMS AND FOOD CHAINS

REFER ALSO TO CITATION(S) 38705, 38706, 38820

38714 (EML—381) **Environmental quarterly, June 1, 1980-September 1, 1980.** (Department of Energy, New York (USA). Environmental Measurements Lab.). 1 Oct 1980. 200p. NTIS, PC A09/MF A01.

This report presents current information from the EML environmental programs, The Air Monitoring Section of the Bhabha Atomic Research Centre, India, the National Radiation Laboratory in New Zealand, and the Woods Hole Oceanographic Institution. The initial section consists of interpretive reports and notes dealing with ^{90}Sr levels in food in India, ^{90}Sr in human bone from San Francisco, the global deposition of ^{90}Sr, origin and deposition history of trace elements and polycyclic aromatic hydrocarbons in Adirondack lakes, description of boat for taking lake sediment cores, interlaboratory comparison of chemical constituent analyses of deposition samples and quality control of halocarbon and nitrous oxide analyses of gas samples collected by aircraft. Subsequent sections include tabulations of ^{90}Sr fallout, chemical constituents of wet and dry deposition, radionuclides and trace metal concentrations in surface air, and ^{90}Sr concentrations in San Francisco and New York diet, milk and tapwater. A bibliography of recent publications related to environmental studies is also presented.

38715 (EML—381(App.)) **Environmental quarterly: appendix.** (Department of Energy, New York (USA). Environmental Measurements Lab.). 1 Oct 1980. 348p. NTIS, PC A15/MF A01.

This report presents current information from the EML environmental programs, The Air Monitoring Section of the Bhabha Atomic Research Centre, India, the National Radiation Laboratory in New Zealand, and the Woods Hole Oceanographic Institution. The initial section consists of interpretive reports and notes dealing with ^{90}Sr levels in food in India, ^{90}Sr in human bone from San Francisco, the global deposition of ^{90}Sr, origin and deposition history of trace elements and polycyclic aromatic hydrocarbons in Adirondack lakes, description of boat for taking lake sediment cores, interlaboratory comparison of chemical constituent analyses of deposition samples and quality control of halocarbon and nitrous oxide analyses of gas samples collected by aircraft. Subsequent sections include tabulations of ^{90}Sr fallout, chemical constituents of wet and dry deposition, radionuclides and trace metal concentrations in surface air, and ^{90}Sr concentrations in San Francisco and New York diet, milk and tapwater. A bibliography of recent publications related to environmental studies is also presented. This appendix contains the relevant data.

38716 (ORNL/TM—7392/V1) **Radiological assessment of residences in the Oak Ridge area. Volume 1. Background information for ORNL environmental impact statement.** Tsakeres, F.S.; Shank, K.E.; Chaudhry, M.Y.; Ahmad, S.; DiZillo-Benoit, P.M.; Oakes, T.W. (Oak Ridge National Lab., TN (USA)). Oct 1980. Contract W-7405-ENG-26. 49p. NTIS, PC A03/MF A01.

Measurements of exposure rates using thermoluminescent dosimeters placed within residences in the Oak Ridge/Knoxville area are presented. The objective of this investigation was to determine the radiation component acquired by Oak Ridge National Laboratory employee personnel dosimeter-security badges during residential badge storage and to develop a model to predict the radiation exposure rate in Oak Ridge/Knoxville-area homes. The exposure rates varied according to building material used and geographic location. Exposure rates were higher in the fall and lower in the spring; stone residences had a higher average dose equivalent rate than residences made of wood. An average yearly exposure rate was determined to be 78 millirems per year for the Oak Ridge-area homes. This value can be compared to the natural background radiation dose equivalent rate in the United States of 80 to 200 millirems per year.

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 37572, 37624, 37636, 37637, 37638, 37650, 37727, 37736, 37742, 38098, 38711, 38887, 38891, 38892, 38893

ENVIRONMENTAL SCIENCES, AQUATIC

ENVIRONMENTAL SCIENCES, AQUATIC

BASIC STUDIES

38717 **Implications of sediment dispersal from long-term, bottom-current measurements on the continental shelf of Washington.** Sternberg, R.W. (Univ. of Washington, Seattle); McManus, D.A. Contract AT(45-10-1725; AT(45-1)-2200. pp 181-194 of Shelf sediment transport. Swift; Duane; Pilkey. Stroudsburg, PA; Dowden, Hutchinson and Ross, Inc. (1972).

Approximately 260 days of current speed and direction data collected 3 m off the seabed of the Washington continental shelf (Hopkins, 1971a) have been analyzed empirically for magnitude and directional response. Data have been separated according to current-speed class (0-10 cm sec^{-1}, 10 to 20 cm sec^{-1}. . .90 to 100 cm sec^{-1}) and histograms have been made to determine the directional variability of the various speed classes. Data within speed classes have been averaged over monthly and annual periods to determine the net direction of movement of bottom water. On the continental shelf of Washington, the bottom currents respond strongly to the surface wind stress. Currents of all speeds show a high degree of directional variability; however, all bottom currents greater than 10 cm sec^{-1} exhibit an overall trend to the northwest. Results indicate that sediment movement frequently occurs on the central continental shelf during the winter months. Lateral sediment dispersal (across the shelf) should occur as a result of the high variability of current direction while a net northward displacement of sediment is also suggested. The maximum annual displacement that could be experienced by a sedimentary particle under the observed conditions is estimated to be approximately 220 km to the northwest.

38718 **Momentum flux and wave spectra measurements from an air-sea interaction buoy.** Sethuraman, S. (Brookhaven National Lab., Upton, NY). Contract EY-76-C-02-0016. *Boundary-Layer Meteorol.;* **16**: 279-291(1979).

Momentum flux measurements by eddy correlation method and wave height measurements with a capacitance-type wave staff were carried out from a stable air-sea interaction buoy anchored 5 km off Tiana Beach, Long Island, New York State. A characteristic height of sea surface h/sub s/ was estimated from wave height spectra. A roughly linear variation of surface shear stress with h/sub s/ was found for an aerodynamically rough sea surface.

38719 **Planktonic and epiphytic desmids (Desmidiales, Chlorophyta) of southern Wisconsin hard waters.** Gough, S.B. (Oak Ridge National Lab., TN). *Rhodora;* **80**: No. 824, 528-544(Oct 1978).

The poorly known desmid flora of southern Wisconsin hard waters was investigated in 20 lakes and 6 calcareous spring ponds. Ten species (2 Closterium, 3 Cosmarium, 1 Euastrum, 1 Micrasterias, 1 Pleurotaenium and 2 Staurastrum taxa) were found. A new species

displayed some polymorphism but most were clearly distinguishable entities. Closterium, Euastrum, Micrasterias and Pleurotaenium were confined to the aufwuchs, and Cosmarium was seldom found elsewhere, whereas Staurastrum usually only occurred in the plankton. Cosmarium botrytis was the most common taxon encountered, whereas species of Euastrum, Pleurotaenium and Micrasterias were only recorded at single localities. Species diversity was greatest in the aufwuchs at all sites and was lower in the spring ponds than in the lakes. Many of the taxa (especially Cosmarium species) occurred over a wide range of chemical conditions but no correlations were found between water chemistry and species diversity.

38720 Empirical orthogonal analysis of Atlantic Ocean surface temperatures. Weare, B.C. (Massachusetts Inst. of Tech., Cambridge, MA). *Q. J. R. Meteorol. Soc.;* **103**: No. 437, 467-478(1977).

An empirical orthogonal function analysis has been performed on monthly mean sea surface temperature observations in the Atlantic Ocean between 70°N and 30°S for the years 1949 to 1969. This method derives the most important modes of variation, defined as those functions which explain the largest total variance in the data field. Such modes are calcuated for two sets of temperature deviations in which the annual cycle is both included and excluded. For the seasonal case, only four functions explain more than 90% of the total variance, whereas in the nonseasonal case, ten functions explain less than 50% of the total. The most important seasonal mode indicates lower minimum temperatures in winter in the later years of study. The dominant nonseasonal function shows a cooling trend starting in early 1951. Nonseasonal functions of the tropical region alone suggest large variations, having a characteristic period of a few months.

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 37549, 37553, 37573, 37633, 38092, 38693, 38701, 38710, 38714, 38939

38721 (COO—2003-30) **Water chemistry and phytoplankton field and laboratory procedures.** Davis, C.O.; Simmons, M.S. (eds.). (Michigan Univ., Ann Arbor (USA). Great Lakes Research Div.). Dec 1979. Contract AS02-76EV02003. 82p. NTIS, PC A05/MF A01.

The purpose of this manual is to serve as a guide for persons using these techniques in water quality studies and as a written record of the methods used in this laboratory at this time. It is anticipated that the manual will be updated frequently as new methods are added and the present ones are further refined. The present methods are all used routinely and have been in regular use for a year or longer. This manual is specifically written as a guide for the collection and analysis of lake water samples from the Laurentian Great Lakes. However, all of the analytical methods are easily adapted for laboratory culture or small lake studies. The descriptions contained in this manual are designed primarily as users guides oriented to the equipment available at the Great Lakes Research Division, and as most of the methods are taken from the literature, the reader is referred to the original articles for a more detailed discussion of the methods.

38722 (KAPL—4128) **Calculating nitrogen sparging rates to deoxygenate and mix water in tanks.** Halbfinger, G.P. (Knolls Atomic Power Lab., Schenectady, NY (USA)). Aug 1980. Contract AC12-76SN00052. 19p. NTIS, PC A02/MF A01.

A design equation can be theoretically derived to calculate the relationship between oxygen concentration, tank geometry, sparging rate, and time for deoxygenating water by nitrogen sparging: el $C_o/C = 0.45\ L/V\ G/sup\ 0.8/t$, where C = desired dissolved oxygen concentration, C_o = initial dissolved oxygen concentration, L = water (tank) height, ft, V = water (tank) volume, ft^3, G = nitrogen flow rate, SCFM, t = time, min. This equation holds for both conventional spargers and water jet exhausters in unpacked tanks. The constants are experimentaly derived. In the model it is assumed that oxygen diffusion from the water to the nitrogen bubble is the rate-controlling step.

38723 (PB—80-805302) **Lead pollution. Volume 3. 1978-January 1980 (citations from the NTIS data base). Report for 1978-Jan 1980.** Brown, R.J. (National Technical Information Service, Springfield, VA (USA)). Feb 1980. 163p. NTIS PC N01/MF N01.

Citations include emission and effluent control technology, detection and analysis; air and water quality data; radioisotope studies; and general studies on lead pollution. Toxicity and effects of lead on plants, animals, and human health are not inclued. (This updated bibliography contains 156 abstracts, 61 of which are new entries to the previous edition.)

38724 (UCRL—52000-80-9, pp 10-14) **Effect of underground coal gasification on groundwater.** Sep 1980.

In Energy and Technology Review.

Underground coal gasification technology raises environmental concerns about the contamination of groundwater. Research is being performed to identify the chemical and physical factors that control the distribution of biologically active contaminants in groundwater near the site of a major coal gasification experiment at Hoe Creek, near Gillette, Wyoming. Experiments have shown that aliphatic compounds and high-molecular-weight aromatic hydrocarbons do not remain in the groundwater for very long after gasification. However, low-molecular-weight aromatic hydrocarbons are of long-term concern.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

WATER

REFER ALSO TO CITATION(S) 37746, 38705

AQUATIC ECOSYSTEMS AND FOOD CHAINS

REFER ALSO TO CITATION(S) 38706

38725 Blooms of surf-zone diatoms along the coast of the Olympic Peninsula, Washington. X. Chemical composition of the surf diatom Chaetoceros armatum and its major herbivore, the Pacific razor clam Siliqua patula. Lewin, J.; Chen, C.; Hruby, T. (Univ. of Washington, Seattle). Contract E-76-S-06-2225-TA26. *Mar. Biol.;* **51**: 259-265(1979).

The surf diatom Chaetoceros armatum T. West, collected from its natural habitat along the Washington coast (USA), had a large inorganic component in the form of a clay coat (consisting of clay minerals, illite and montmorillonite) surrounding the cell chains: 63% of the dry weight of the natural material collected in November was inorganic. The organic fraction was composed of 67.6% lipid, 29.7% protein, and 1.3% carbohydrate. Cultured cells were likewise high in protein and lipid and low in carbohydrate. Traces of chitin found in field samples were probably a contaminant, since chitin was absent from cultured cells. This diatom species serves as a major food source throughout the year for the Pacific razor clam Siliqua patula Dixon, which inhabits these same beaches. Protein constituted 47% and lipid 42% of the dry weight of razor clam tissue. The fatty acid distribution in the diatom lipid resembled that previously reported for other diatom species; similarly, the fatty acid distribution of the clam lipid was similar to that previously reported for other bivalve molluscs. The clam fatty acids differed in chain length and degree of saturation from those extracted from its food source, indicating an active fatty acid metabolism in the clam.

THERMAL EFFLUENTS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 38844

38726 (PB—80-133135) **A field study of the physical effects of thermal discharges at La Cygne Lake, Kansas and appendices. Master's thesis.** Wagner, J. (Kansas Univ., Lawrence (USA). Dept. of Chemical and Petroleum Engineering). 1979. 723p. NTIS, PC A99/MF A01.

Field studies were conducted at La Cygne Lake (871 ha) in eastern Kansas in order to determine the physical effects of thermal discharges from an 840 Mw power generating station. The results cover three and one-half years of study, including periods before and after plant startup. Temperature measurements defined the seasonal variation in lake temperatures, which were dominated by local climatological conditions. Discharge of thermal effluents resulted in both vertical and horizontal temperature gradients. Detailed descriptions of the temperature distributions under several combinations of meteorological and plant operating conditions showed a different temperature distribution for each set of conditions. There was no 'typical' temperature distribution. In all cases lake temperatures were three dimensional and closely related to current velocities. One-dimensional models formulated on an oversimplification of lake hydrodynamics were found to be inadequate for shallow lakes, such as La Cygne Lake.

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 37594, 37800

ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

REFER ALSO TO CITATION(S) 37686, 37979

38727 **Large scale wind energy program for the state of California.** Ginosar, M. Los Angeles, CA; Univ. of California (1978). 164p. University Microfilms Order No. 79-15,662.

Thesis (Ph. D.).

Wind-electric energy is a sleeping giant. Its large energy capabilities, competitive economics and its social and environmental advantages are not generally known. Wind-electric energy, however, can and should be one of the major renewable energy supplies in California. This document proposes and provides the rationale for a large-scale wind-electric energy program for California. It is written for decision makers; therefore, simplified calculations and explanations are used throughout. It is not intended to be a technical document, although many technical items are presented in support of the program. This plan is based on the idea that time is one of the most critical elements in developing renewable energy supplies.

SOCIAL AND ECONOMIC STUDIES

REFER ALSO TO CITATION(S) 37975, 38219, 38250, 38253, 38671, 38681

38728 (COO—4287-16) **Analysis of some potential social effects of four coal technologies.** Walker, C.A.; Gould, L.C. (Yale Univ., New Haven, CT (USA). Institution for Social and Policy Studies). Sep 1980. Contract AS02-77EV10125. 110p. NTIS, PC A06/MF A01.

This is an analysis of the potential social impacts of four coal technologies: conventional combustion, fluidized-bed combustion, liquifaction, and gasification. Because of their flexibility, and the abundance and relatively low costs of coal, the potential benefits of these technologies would seem to outweigh their potential social costs, both in the intermediate and long term. Nevertheless, the social costs of a coal industry are far more obscure and hard to quantify than the benefits. In general, however, it maybe expected that those technologies that can be deployed most quickly, that provide fuels that can substitute most easily for oil and natural gas, that are the cheapest, and that are the most thermally efficient will minimize social costs most in the intermediate term, while technologies that can guide energy infrastructure changes to become the most compatable with the fuels that will be most easily derived from inexhaustible sources (electricity and hydrogen) will minimize social costs most in the long run. An industry structured to favor eastern over western coal and plant sites in moderate sized communities, which could easily adapt to inexhaustible energy technologies (nuclear or solar) in the future, would be favored in either time period.

38729 (PB—80-143837) **Resources and pollution control: demonstration of a comprehensive assessment. Final report.** (Environmental Protection Agency, Washington, DC (USA). Office of Environmental Processes and Effects Research). Sep 1979. 885p. NTIS, PC A99/MF A01.

The purpose of the project was to develop and demonstrate a methodology for simultaneously projecting future pollution control costs for all economic activities subject to Federal regulations, which utilized consistent assumptions relating to official Federal projections of the state of the Nation's economy. To assure valid simulation of the impacts of the regulations, the projection model was developed with a scale of sectoral detail that allowed analysis of each industry-specific effluent or emission regulation in effect at the time (nearly 400 sectors). Further the secondary effects of pollution control expenditures on the economy were simulated. The report demonstrates the utility of the methodology for the intended analyses.

38730 **Society's valuation of life saving in radiation protection and other contexts.** Cohen, B.L. (Pittsburgh Univ., PA (USA); Argonne National Lab., IL (USA)). *Health Phys.;* **38**: No. 1, 33-51(Jan 1980).

Various situations are described in which societal action may be interpreted as a dollar value placed on averting a human fatality, and numerical values are derived in each case. Situations included are a variety of medical screening and medical care programs and of automobile and highway safety measures, food for overseas relief, air pollution control, fire prevention, industrial safety, and several radiation-related activities including standards for radium in drinking water, radwaste systems in nuclear plants, and defence and civilian high-level waste management. Values varying from a few thousand dollars to hundreds of million of dollars per fatality averted are obtained. An attempt to derive data of this type from polling is described. The problem of discounting when money is spent now to save lives far in the future (as with nuclear waste) is discussed. It is concluded that nearly all of the vast variation in the results is unjustified and represents a need for educating the public, especially in the area of radiation protection.

38731 **Some biological, legal, social, and economic aspects of the culture of the red alga Iridaea cordata on nets in Puget Sound.** Mumford, T.F. Jr. pp 221-22 of Use, study and management of Puget Sound. Seattle, WA; University of Washington (1977).

From Proceedings of the use, study and management of Puget Sound; Seattle, WA, USA (23 Mar 1977).

The culture of Itidaea on nets still has many biological aspects that must be investigated before a large-scale commercial operation is feasible. A method for artificial seeding of nets must be perfected. This will allow even, dense sets of a particular strain or type of seaweed. Disease and herbivory will have to be studied and controlled. Growth rates under varying current and light intensities will have to be determined to allow selection of net sites. Harvesting strategies must be devised, and a harvesting machine designed and perfected. The possibility of providing seed stock for tank culture is under investigation, as well as increasing carrageenan content through nitrogen starvation on plants in tanks after harvesting. When the biological part of the system is better defined, then the legal, economic and social aspects will be more easily approached. The development of techniques for the growth of Iridaea on nets will hopefully be transferable to other algae. Future sources of foodstuffs, agar, pharmaceuticals and large-scale biomass that can be converted to methane and other hydrocarbons may all come from seaweeds grown on artifical substrata. The sheltered waters of Puget Sound are a unique resource and offer a site for aquaculture development unparalleled on the west coast of the US. Protection from storm and wave damage allows the placement of light-weight, inexpensive structures. Water quality and nutrient levels are high and tidal action assures good water movement needed for good algal growth. How aquaculture fits into the socio-economic matrix of the people of Washington will be one of the most fascinating developments in our near future.

ASSESSMENT OF ENERGY TECHNOLOGIES

REFER ALSO TO CITATION(S) 37886, 37976

ENVIRONMENTAL IMPACT STATEMENTS

REFER ALSO TO CITATION(S) 37643, 37727, 37728

BIOMEDICAL SCIENCES, BASIC STUDIES

38732 **Log-linear models in the analysis of disease prevalence data from survival/sacrifice experiments.** Mitchell, T.J. (Union Carbide Corporation, Oak Ridge, TN); Turnbull, B.W. Contract W-7405-ENG-26. *Biometrics;* **35**: 221-234(Mar 1979).

This paper considers the problem of analyzing disease prevalence data fronm survival experiments in which there may also be some serial sacrifice. The assumptions needed for standard analyses are reviewed in the context of a general model recently proposed by the authors. This model is then reparametrized in log-linear form, and a generalized EM algorithm is utilized to obtain maximum likelihood estimates of the parameters for a broad class of unsaturated model. Tests based on the relative likelihood are proposed to investigate the effects of treatment, time, and the presence of oher diseases on the prevalences and lethalities of specific disease of interest. An example is given, using data from a large experiment to investigate the effects of low-level radiation on laboratory mice. Finally, some possible directions for future research are indicated.

BEHAVIORAL BIOLOGY

REFER ALSO TO CITATION(S) 38807, 38904

38733 (ORNL/TM—6803/52) **White-tailed deer (Odocoileus virginianus) on the Department of Energy's Oak Ridge Reservation: 1979 status report.** Kitchings, J.T.; Story, J.D. (Oak Ridge National

Lab., TN (USA)). Oct 1980. Contract W-7405-ENG-26. 40p. NTIS, PC A03/MF A01.

Seventy-three white-tailed deer (Odocoileus virginianus) were killed by vehicles on the Department of Energy's Oak Ridge Reservation during 1979, an increase of twenty-eight over 1978. Patterns of mortality were similar to those reported in previous documents. During the year, the highest number of deer was killed in October, November, and December. Throughout the year almost twice as many males as females were killed. Reproductive data collected from 19 does revealed that breeding during 1979 probably occurred from early December through early January. Night-lighting showed the same general trends in population increase that were apparent in the road-kill sample. The number of deer night-lighted in 1976 was 11/110 km, while in 1979 the number rose to 40/100 km. the habitat evaluation which began in 1978 was continued in 1979, with a survey of the number of deer trails from a given habitat-type supplementing the radiotelemetry work. Results indicated a preference for cutover areas where immature pine, eastern red cedar, and grasses dominated and for pine plantations where shelter was provided. Upland hardwoods areas were the least preferred.

38734 Alternative methods of phylogenetic inference and their interrelationship. Felsenstein, J. Contract EY-76-S-06-2225-5. *Syst. Zool.;* **28**: 49-62(1979).

A probabilistic model of evolution in a character is presented. It involves two character states, 0 and 1. The population may have a third state, 01, in which there is polymorphism for both character states. There are three evolutionary events in the model: origination of state 1, reversion from state 1, and loss of polymorphism, plus an event corresponding to total misinterpretation of the character by the taxonomist. The maxium likelihood method of estimating the phylogeny is described. When the probabilities of the four events are taken to be extreme, then depending on their relative sizes under different circumstances four different phylogenetic inference methods emerge as maximum likelihood methods. Three are known: the Camin-Sokal parsimony method, Farris's Dollo parsimony method, and the Estabrook-Johnson-McMorris compatibility method. A new method, the polymorphism parsimony method, also emerges. It explains parallelism and convergence by persistence of character-state polymorphism after a unique orgin of the derived character state, and attempts to find that evolutionary tree which requires the least extent of polymorphism. Details of implementation of the polymorphism parsimony method are given. Some variants of the evolutionary model are discussed, involving unrooted character state trees. The use of the model to resolve a paradox which arises when we attempt to apply the Dollo parsimony method to multiple-state characters is briefly considered.

38735 Isolation by distance: reply to Lalouel and Morton. Felsenstein, J. (Univ. of Washington, Seattle). Contract EY-76-S-06-2225. *Ann. Hum. Genet.;* **42**: 523-527(1979).

The greatest part of Lalouel's argument concerns a single point. I had interpreted Malecot as making a model of the distribution, reproduction and migration of organisms in a true spatial continuum. Lalouel argues that Malecot intended no such thing, that he was making a continuous approximation to a discrete-colony stepping-stone model. In the continuous model, the assumptions of constant expected density, Poisson variation of offspring number, and independent migration of individuals are mutually incompatible, and a model based on all three cannot be erected. In stepping-stone models, no such difficulty arises, as I have previously noted (1975, 1976). So there is no demographic difficulty with the continuous approximation.

38736 Management of highway right-of-way for waterfowl in North Dakota. Voorhees, L.D.; Cassel, J.F. (North Dakota State Univ., Fargo). *Transp. Res. Rec.;* **694**: 43-47(1978).

Waterfowl nesting was studied on 1.6-km (1-mile) blocks of land along the I-94 right-of-way in North Dakota. Alternate 1.6 -km blocks were maintained in an early successional stage by annual fall mowing; the other blocks, which represented later successional stages, were left unmowed. Initial investigations revealed higher densities of duck nests and higher nest success in unmowed than in mowed right-of-way areas. No change was found in nesting preference in the unmowed areas from 1969 to 1972 as the vegetation aged, but patterns of nest success in the two types of areas over the 4-year period were significantly different. Nest success in unmowed blocks is shown to have declined between 1969 and 1972. Recommendations are presented for ensuring maximum waterfowl production along I-94.

38737 Blooms of surf-zone diatoms along the coast of the Olympic Peninsula, Washington. IX. Factors controlling the seasonal cycle of nitrate in the surf at Copalis Beach (1971 through 1975). Lewin, J. (Univ. of Washington, Seattle). *Estuarine Coastal Mar. Sci.;* **7**: 173-183(1978).

Nitrate depletion in the upper water layers beyond the breaker zone at Copalis Beach, Washington, takes place in April of each year due to spring phytoplankton blooms. In 1974, Thalassiosira pacifica was the species responsible for almost all of the nitrate depletion over a considerable ocean area beyond the region of the breakers. This same nitrate-depleted water was also characteristic of the surf zone in April of each year (1971 through 1975). Between mid-April and mid-October, reintroduction of nitrate into the surf region depends on encroachment of upwelled oceanic deep water high in nitrate; in 1971, when there was only weak upwelling, nitrate in the surf remained depleted over an extended period (6 months). Upwelling can be masked by the presence of freshwater discharge from rivers and streams (as in 1971, 1972, and 1974). In the summer of 1973, when the rate of river discharge was at an all-time record low, nitrate concentrations in surf samples were higher than in any of the other summers during our study period. Cell concentrations of both surf diatom species were reduced in summer; Asterionella socialis disappeared completely in mid or late summer, and Chaetoceros armatum showed symptoms of physiological stress. The annual cycles of abundance of each species seemed to be repeated in more or less the same fashion from year to year, in spite of the very different patternsobserved in nirate concentrations from summer to summer. This points to the importance of ammonia as an alternate nitrogen source for surf diatoms, particularly during summer months.

TRACER TECHNIQUES

38738 Altered metabolism of the methionine methyl group in the leukocytes of patients with schizophrenia. Ismail, L.; Sargent, T. III; Dobson, E.L.; Pollycove, M. (Univ. of California, Berkeley). *Biol. Psychiatry;* **13**: No. 6, 649-660(1978).

Previous work has indicated that abnormal methylation processes may be associated with schizophrenia. In this study, leukocytes from patients with schizophrenia were incubated with methyl-^{14}C-L-methionine and the evolved $^{14}CO_2$ measured. With increasing concentration of methionine, the evolved $^{14}CO_2$ was lower in the patients than in normal control subjects. The incorporation of ^{14}C into protein was the same in both groups, and when carboxyl-^{14}C-L-methionine was used the evolved $^{14}CO_2$ was the same in both groups, thus excluding the possibility that altered incorporation into protein or oxidation of the methionine molecule as a whole were responsible. The observed differences in methionine-methyl metabolism suggest that an abnormality in transmethylation processes or in oxidation of the methyl group to CO_2 is associated with schizophrenia. That this occurs in a peripheral tissue indicates that the abnormality is not restricted to the central nervous system.

BIOCHEMISTRY

REFER ALSO TO CITATION(S) 37597, 37785, 37795, 37840, 38413, 38457, 38467, 38468, 38490, 38725, 38785, 38786, 38787, 38788, 38789, 38790, 38794, 38795, 38802, 38808, 38809, 38812, 38815, 38818, 38819, 38829, 38830, 38835, 38848, 38851, 38852, 38859, 38865, 38866, 38872, 38881

38739 (CONF-7808127—1) **Assessment of polyamines in the control of cell growth and differentiation in cultured Friend erythroleukemia cells.** Weeks, C.E.; Slaga, T.J.; Herrmann, A.L.; McKeown, C.K.; Huberman, E. (Oak Ridge National Lab., TN (USA)). 1978. Contract W-7405-ENG-26. 10p. NTIS, PC A02/MF A01.

From 3. international conference on differentiation: differentiation and neoplasia; Minneapolis, MN, USA (28 Aug 1978).

Treatment of cultures of Friend murine erythroleukemia (FL) cells with α-methylornithine (MO), an inhibitor of polyamine biosynthesis, caused increased ornithine decarboxylase (ODC) activity and decreased levels of putrescine and spermidine. α-Methylornithine also inhibited cell growth and the dimethylsulfoxide (DMSO)-induced terminal differentiation. Addition of putrescine abrogated these effects. 12-O-Tetradecanoylphorbol-13-acetate (TPA), a potent inhibitor of DMSO-induced differentiation in these cells, did not itself effect ornithine decarboxylase activity. Neither MO nor TPA counteracted the other's action on cell growth and differentiation. These results suggest that: (1) alteration of polyamine levels, but not necessarily changes in ODC activity, may be involved in regulation of growth and differentiation of FL cells and (2) the effect of TPA on the inhibition of DMSO-induced differentiation in FL cells may not be directly mediated via polyamine biosynthesis.

38740 Human endonuclease specific for apurinic/apyrimidinic sites in DNA. Linsley, W.S.; Penhoet, E.E.; Linn, S. (Univ. of California, Berkeley). Contract AT(04-3)34. *J. Biol. Chem.;* **252**: No. 4, 1235-1242(1977).

Six chromatographically distinct forms of endonuclease active on apurinic and apyrimidinic sites in DNA have been purified away from DNA phosphatases, DNA N-glycosidases, and other DNases of human placenta. The forms seem to be monomeric proteins of 27,000 to 31,000 daltons, and although catalytically similar, they can be distinguished from one another on the basis of

substrate K/sub m/ and the effects of small molecules such as ATP. Analysis of enzymatic activity on a spectrum of damaged DNA substrates indicates that the enzyme forms probably act at an appreciable rate only adjacent to the phosphodiester bond of deoxyribose lacking a base (purine or pyrimidine) in duplex DNA; such sites can be formed by treating the DNA with acid, alkylating agents, DNA N-glycosidases, and, probably, x-rays and OsO_4. The incision is made so as to form a deoxyribose 5'-phosphate and a 3'-hydroxynucleotide.

38741 (LA-UR—80-2534) **Relationships between histone phosphorylation and cell proliferation.** Gurley, L.R.; D'Anna, J.A.; Halleck, M.S.; Barham, S.S.; Walters, R.A.; Jett, J.H.; Tobey, R.A. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 38p. (CONF-800984—2). NTIS, PC A03/MF A01.

From Protein phosphorylation meeting; Cold Spring Harbor, NY, USA (Sep 1980).

From studies with various Peromyscus cell lines, correlations were made which led to the proposal that H2A phosphorylation is most active in constitutive heterochromatin. Recent studies on the two H2A variants found in these cells have revealed that the high level of H2A phosphorylation associated with heterochromatin is not the result of an increase in H2A phosphorylation rate or an increase in the number of phosphorylation sites, but rather, is due to an increase in the proportion of one of the H2A variants which is more highly phosphorylated than the other. If H2A phosphorylation is necessary for the constitutive heterochromatin state, it is reasonable that the cell would accomplish the generation of this structure by permanently installing a more highly phosphorylated H2A in the heterochromatin nucleosome rather than by trying to modulate the phosphorylation rate in such a condensed structure. The proposal that histone phosphorylation is involved with the condensed structures of chromatin is based primarily on correlations between histone phosphorylation measurements and cellular phenomena. One proof that this concept is correct ultimately rests in the ability to demonstrate these correlations in isolated chromosomes and chromatin fractions. This demonstration is presently limited by the excessive dephosphorylation of histones which occurs during the isolation of chromosomes and chromatin fractions. Thus, the demonstration of an effective inhibitor of histone dephosphorylation which is compatible with the isolation of nuclear structures and chromatin fractions having native morphologies is essential for future studies on the biological function of histone phosphorylation. (ERB)

38742 (LA-UR—80-2535) **Phosphorylation of the butyrate-enhanced protein, histone H1^0, in Chinese hamster cells.** D'Anna, J.A.; Gurley, L.R.; Becker, R.R.; Barham, S.S.; Walters, R.A.; Tobey, R.A. (Los Alamos Scientific Lab., NM (USA); Oregon State Univ., Corvallis (USA). Dept. of Biochemistry and Biophysics; Mayo Clinic, Rochester, MN (USA)). 1980. Contract W-7405-ENG-36. 51p. (CONF-800984—1). NTIS, PC A04/MF A01.

From Protein phosphorylation meeting; Cold Spring Harbor, NY, USA (Sep 1980).

Although the model studies focus attention upon the ability of H1 phosphorylation to alter H1-DNA interactions, the molecular effects of H1 phosphorylation in chromatin remain unresolved. Part of the difficulty has been technical. For example, most H1 molecules become dephosphorylated during the isolation of chromatin and chromosomes; therefore, it has not been possible to compare the properties of fully phosphorylated chromatin or chromatin subunits with those of their unphosphorylated counterparts. Recent reports, however, suggest that it may be possible to replace unphosphorylated H1 with phosphorylated H1 in oligonucleosomes, nucleosomes, and chromatosomes. Hence, in the near future, we anticipate significant advances in this area.

38743 **Graphical techniques for kinetic data analyses of alkaline phosphatase.** Frazer, J.W.; Brand, H.R. (Univ. of California, Livermore). Contract W-7405-ENG-48. *Anal. Chem.;* **52**: No. 11, 1730-1738(Sep 1980).

The use of an automated reactor for the experimentation and on-line graphics for the rapid and exhaustive analysis of experimental data is described. Traditional (linear) methods are used for selecting the most promising model for the alkaline phosphatase catalyzed reaction from a set of ten models under consideration. Then, nonlinear techniques for model selection are used and compared with traditional techniques. In both approaches, interactive graphics techniques are used to advantage for evaluating various models and for examining the quality of the experimental data.

38744 **Diffusion in rigid bilayer membranes. Use of combined multiple pulse and multiple pulse gradient techniques in nuclear magnetic resonance.** Crawford, M.S. (Ames Lab., IA); Gerstein, B.C.; Kuo, A.L.; Wade, C.G. *J. Am. Chem. Soc.;* **102**: No. 11, 3728-3732(21 May 1980).

Combined NMR multiple pulse homonuclear decoupling and multiple pulse gradient techniques have been used to determine the self-diffusion coefficients at 25°C of the phospholipids in the L/sub β'/(gel) phase of L-α-dipalmitoylphosphatidylcholine in a 15% (w/w) D_2O model membrane and of potassium oleate in a 30% (w/w) D_2O lamellar phase (above the phase transition). The values found, 1.6×10^{-10} and 1.3×10^{-8} cm^{2}S^{-1}, respectively, are considered in reasonable agreement with values obtained by other investigators using fluorescence photobleaching recovery. The technique has the advantage that it monitors lipid protons and hence avoids possible complications of added probes. The use and limitations of the method are discussed, and the values found for diffusion are compared with those determined or estimated by other methods.

38745 **Cyanobacterial phycobilisomes: selective dissociation monitored by fluorescence and circular dichroism.** Rigbi, M.; Rosinski, J.; Siegelman, H.W.; Sutherland, J.C. (Brookhaven National Lab., Upton, NY). *Proc. Natl. Acad. Sci. U.S.A.;* **77**: No. 4, 1961-1965(Apr 1980).

Phycobilisomes are supramolecular assemblies of phycobiliproteins responsible for photosynthetic light collection in red algae and cyanobacteria. They can be selectively dissociated by reduction of temperature and buffer concentration. Phycobilisomes isolated from Fremyella diplosiphon transfer energy collected by C-phycoerythrin and C-phycocyanin to allophycocyanin. The energy transfer to allophycocyanin is nearly abolished at 2°C, as indicated by a blue shift in fluorescence emission, and is accompanied by a decrease in the circular dichroism in the region of allophycocyanin absorbance. Further dissociation of the phycobilisomes can be attained by reduction of buffer concentration and holding at 2°C. Energy transfer to C-phycocyanin is nearly abolished, and decreases occur in the circular dichroism in the region of C-phycocyanin and C-phycoerythrin absorbance. Complete dissociation of the phycobilisomes at low buffer concentration and 2°C requires extended time. Energy transfer to C-phycocyanin is further reduced and the circular dichroism maximum of C-phycoerythrin at 575 nm is lost. Circular dichroism provides information on the hexamer-monomer transitions of the phycobiliproteins, whereas fluorescence is indicative of hexamer-hexamer interactions. We consider that hydrophobic interactions are fundamental to the maintenance of the structure and function of phycobilisomes.

38746 **Comparison of the behavior of chymotrypsin and cathepsin B towards peptidyl diazomethyl ketones.** Watanabe, H.; Green, G.D.J.; Shaw, E. (Brookhaven National Lab., Upton, NY). *Biochem. Biophys. Res. Commun.;* **89**: No. 4, 1354-1360(28 Aug 1979).

Chymotrypsin is not inactivated by benzyloxycarbonyl-phenylalanyl diazomethyl ketone although disappearance of the diazo group can be followed spectroscopically. It is also inert to various dipeptide derivatives. Cathepsin B on the other hand is inactivated by this reagent, as described earlier as well as by other peptidyl diazomethyl ketones. It appears from initial studies that a phenylalanyl residue in the penultimate position of the inhibitor is favorable for effectiveness. Benzyloxycarbonyl-Phe-AlaCHN_2 emerges from this work as a powerful, relatively soluble inactivator of bovine spleen cathepsin B with K/sub i/ = 1.7×10^{-6}M.

38747 **Sites including those of origin and termination of replication are not freely available to single-cut restriction endonucleases in the supercompact form of Simian virus 40 minichromosome.** Das, G.C.; Allison, D.P.; Niyogi, S.K. (Univ. of Tennessee, Oak Ridge). *Biochem. Biophys. Res. Commun.;* **89**: No. 1, 17-25(12 Jul 1979).

Simian virus 40 minichromosomes, isolated from both virions (MV) and infected cells (MI), have highly compact structures in buffer containing 0.15 M NaCl and sediment with S values of about 90 to 100 and 115 to 130, respectively. Under the electron microscopy, also, MI appear the more compact of the two. Only 30 to 35% of the sites of origin and termination of replication in MV are freely available to the restriction endonucleases Bgl 1 and Bam H1. MV are similarly resistant to Eco R1 and Hpa II. In contrast, almost no sites in MI are available to any of the above single-cut endonucleases. In 0.6 M NaCl, MV and MI change to relaxed structures of 45 to 55 S and 50 to 60 S, respectively, containing 20 to 24 nucleosomes per genome, and become more sensitive to Bgl 1, Bam H1, Eco R1, and HPa II.

38748 **Mouse albumin mRNA in liver and a hepatoma cell line.** Brown, P.C.; Papaconstantinou, J. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *J. Biol. Chem.;* **254**: No. 12, 5177-5183(25 Jun 1979).

For studies on the regulation of serum protein synthesis, we isolated mouse albumin mRNA by direct immunoprecipitation of albumin-synthesizing polysomes and oligo(dT)-cellulose chromatography of albumin polysomal RNA. This albumin mRNA sediments at about 17 S, which corresponds to a molecular weight of approximately 6.5×10^5 or 2,000 nucleotides. DNA, complementary to albumin mRNA, was synthesized with avian myeloblastosis virus RNA-dependent DNA polymerase. Hybridization of the cDNA to its template mRNA displayed a melting temperature of 89°C when analyzed by thermal elution from a hydroxylapatite column, indicating a high degree of fidelity of the base pairings. Data from the hybridization analyses and cell-free translation studies indicate that the albumin mRNA is about 80 to 85% pure. Quantitation of albumin mRNA in total cytoplasmic RNA revealed that mouse liver contains

about 10-fold more albumin mRNA sequences than Hepa-2 cells, a permanent mouse hepatoma cell line that has maintained the capacity to synthesize albumin.

38749 Interspersion of highly repetitive DNA with single copy DNA in the genome of the red crab, Geryon quinquedens. Christie, N.T. (Univ. of Tennessee, Oak Ridge); Skinner, D.M. *Nucleic Acids Res.;* **6**: No. 2, 781-796(Feb 1979).

Kinetic analysis of the reassociation of 420 nucleotide (NT) long fragments has shown that essentially all of the repetitive sequences of the DNA of the red crab Geryon quinquedens are highly repetitive. There are negligible amounts of low and intermediate repetitive DNAs. Though atypical of most eukaryotes, this pattern has been observed in al other brachyurans (true crabs) studied. The major repetitive component is subdivided into short runs of 300 NT and longer runs of greater than 1200 NT while the minor component has an average sequence length of 400 NT. Both components reassociate at rates commonly observed for satellite DNAs. Unique among eukaryotes the organization of the genome includes single copy DNA contiguous to short runs (300 NT) of both repetitive components. Although patent satellites are not present, subsets of the repetitive DNA have been isolated by either restriction endonuclease digestion or by centrifugation in Ag^+ or Hg^{2+}/Cs_2SO_4 density gradients.

38750 Cytochrome function in the cyclic electron transport pathway of chloroplasts. Slovacek, R.E.; Crowther, D.; Hind, G. (Brookhaven National Lab., Upton, NY). *Biochim. Biophys. Acta;* **547**: 138-148(1979).

Flash excitation of isolated intact chloroplasts promoted absorbance transients corresponding to the electrochromic effect (P-518) and the α-bands of cytochrome b_6 and cytochrome f. Under conditions supporting coupled cyclic electron flow, the oxidation of cytochrome b_6 and the reduction of cytochrome f had relaxation half-times of 15 and 17 ms, respectively. Optimal poising of cyclic electron flow, achieved by addition of 0.1 μM 3-(3,4-dichlorophenyl)-1,1-dimethylurea, increased phosphorylation of endogenous ADP and prolonged these relaxation times. The presence of NH_4Cl, or monensin plus NaCl, decreased the half-times for cytochrome relaxation to approximately 2 ms. Uncouplers also revealed the presence of a slow rise component in the electrochromic absorption shift, with formation half-time of about 2 ms. The inhibitors of cyclic phosphorylation antimycin and 2,5-dibromo-3-methyl-6-isopropyl-p-benzoquinone abolished the slow rise in the electrochromic shift and prolonged the uncoupled relaxation times of cytochromes b_6 and f by factors of ten or more. These observations indicate that cytochrome b_6, plastoquinone and cytochrome f participate in a coupled electron transport process responsible for cyclic phosphorylation in intact chloroplasts. Estimations of cyclic phosphorylation rates from 40 to 120 μmol ATP/mg chlorophyll per h suggest that this process can provide a substantial fraction of the ATP needed for CO_2 fixation.

38751 Energy transfer protein in coelenterate bioluminescence. Ward, W.W.; Cormier, M.J. (Univ. of Georgia, Athens). Contract EY-76-S-09-0635. *J. Biol. Chem.;* **254**: No. 3, 781-788(1979).

Bioluminescence in the sea pansy, Renilla reniformis, a marine anthozoan coelenterate, is a complex process involving the participation of three proteins. These are: (1) the luciferin-binding protein, (2) the enzyme luciferase, and (3) the green-fluorescent protein (GFP). Luciferin-binding protein is a specific subtrate-binding protein which binds one molecule of coelenterate-type luciferin per molecule of protein and which then releases luciferin in the presence of Ca^{2+}. Luciferase is the enzyme which catalyzes oxidation (by O_2) of coelenterate-type luciferin, leading to the production of CO_2 and enzyme-bound excited-state oxyluciferin. Oxyluciferin may then emit blue light by a direct de-excitation pathway or may transfer excitation energy to GFP. GFP is a noncatalytic accessory protein which accepts excitation energy from oxyluciferin, by radiationless energy transfer, and then emits green bioluminescence. In this paper the purification methods and physicochemical characteristics of GFP from R. reniformis are presented, and in the companion article luciferin-binding protein is described.

38752 Apolipoproteins of plasma lipoproteins: behavior in solution. Scanu, A.M.; Teng, T.L. (Univ. of Chicago, IL). Contract EY-76-C-76-02-0069. pp 107-121 of Biochemistry of atherosclerosis. Scanu, A.M.; Wissler, R.W.; Getz, G.S. (eds.). New York, NY; Marcel Dekker, Inc. (1979).

In this review, we provide an account of recent developments regarding the physicochemical properties of plasma apolipoproteins in solution and attempt to relate these properties to the capacity of apolipoproteins to bind lipids. The acquisition of new information on apolipoprotein chemistry has been remarkably rapid during the last few years. The complete amino acid sequence of many of the major apolipoproteins is now known, and work is proceeding on the elucidation of the other purified apolipoproteins both in humans and in other animal species. Comparatively less inforation is available on the molecular properties of the apolipoproteins in solution in their lipid-free state. Stimulated by the knowledge of the primary sequence of many of these apolipoproteins, investigators are now directing their efforts toward this area of research, and several accounts have already appeared. We wish here to examine these reports and to assess the information obtained in the context of the overall structure of plasma lipoproteins as discussed in Chapters 1 and 3. We will limit ourselves to those apolipoproteins for which substantial information is available. Nonetheless, such a discussion ought to provide the basis for an assessment of the complex and still controversial state of the field, and for the planning of future experiments. We begin our analysis with the A apolipoproteins.

38753 Photosynthetic reaction centers. Olson, J.M. (Brookhaven National Lab., Upton, NY); Thornber, J.P. pp 279-340 of Membrane proteins in energy transduction. Capaldi, R.A. (ed.). New York, NY; Marcel Dekker, Inc. (1979).

Photosynthetic reaction centers are the places where primary photochemistry occurs in photosynthetic membranes. Every reaction center consists of a primary electron donor (usually a chlorophyll dimer) and a primary electron acceptor associated with a specific protein. The primary donor in the excited state transfers an electron to the primary acceptor, and electronic excitation energy is thereby converted to chemical free energy. In some bacterial reaction centers an intermediate electron carrier (probably a bacteriopheophytin molecule) is known to be involved in the electron transfer from primary donor to primary acceptor. In photosynthetic membranes reaction centers are combined with light-harvesting pigments which absorb most of the light and funnel the excitation energy to the reaction centers for photochemical conversion. Most of the chlorophyll in a membrane collects light and only a small fraction (1 to 10%) functions in reaction centers. Reaction centers use either bacteriochlorophyll (Bchl) a or b or chlorophyll (Chl) a as primary donor. All other types of chlorophyll and the bulk of Bchl a or b or Chl a serve only as light-harvesting pigments. Reaction centers of purple bacteria contain either Bchl a or b, whereas those of green bacteria contain Bchl a only. Cyanobacteria (blue-green algae) and chloroplasts of eukaryotes contain two types of reaction centers corresponding to photosystems I and II; both types contain Chl a as a primary donor. This chapter describes the biochemical and photochemical characteristics of the photosynthetic reaction center of purple bacteria, green bacteria, blue-green algae, and plant chloroplasts.

38754 Fluorescent 2-aza-ϵ-adenosine derivatives of polyadenylic acid, polyuridylic acid, and polyinosinic acid. Yip, K.F.; Tsou, K.C. (Univ. of Pennsylvania, Philadelphia). *Biopolymers;* **18**: 1389-1405(1979).

A new fluorescent analog of adenosine, $1,N^6$-etheno-2-aza-adenosine, has been incorporated into polynucleotides by polynucleotide phosphorylase polymerization of $1,N^6$-etheno-2-aza-adenosine-5'-diphosphate and adenosine-5'-diphosphate, uridine-5'-diphosphate, or inosne-5'-diphosphate. These new oligonucleotides possess high fluorescence when excited at 358 nm and emit at 495 nm. The ratio of the fluorescent and nonfluorescent portions of the copolymer can be controlled by the initial composition of the 2-aza-ϵ-adenosine-diphosphate and corresponding nucleoside diphosphate. Fluorescent copolymers with a ratio varying from 1.6 to 35 have thus been synthesized. The physicochemical study of copolymers containing less than 10% of the $1,N^6$-etheno-2-aza-adenosine moiety showed that they are similar to poly(A), poly(U), or poly(I). Therefore, fluorescence and polarization study of the $1,N^6$-etheno-2-aza-adenosine residues that have been incorporated into the copolymer provides a sensitive indicator for the structure of the copolymer. Potentially these new copolymers may provide unique roles in probing the structure of poly(C) and poly(A) in cellular mRNA.

38755 Circular dichroism of helical polynucleotides calculated by the linear response method. Redmann, S.M. Jr.; Rhodes, W. (Florida State Univ., Tallahassee). Contract EY-76-S-05-2690. *Biopolymers;* **18**: 393-409(1979).

Linear response theory in the decorrelation or random-phase approximation is used to calculate the absorption and CD spectra of model helical polymers, including single-stranded polyadenylic acid. The method, which makes use of infinite polymer selection rules for the linear response tensor, has the advantages that (1) only a few three-dimensional matrices need be inverted; (2) spectral band shapes of the polymer arise naturally from those of the monomer, as well as from the geometry-dependent interactions in the helix; and (3) the spectral dependence of geometrical factors of the helix is made transparent. It is found that the structure of the polymer CD spectrum depends critically on monomer bandshape. An asymmetric CD spectrum, similar to some experimental spectra, arises from either a Gaussian or a composite monomer band. Single-stranded polyadenylic acid spectra are sensitive to helix geometry in the region 200 to 240 nm, in a reasonable agreement with experimental spectra. This sensitivity arises from the 207-nm monomer transition, and the results suggest that this region of the spectrum should be more fully exploited as a tool for helix geometry studies.

38756 Photosynthetic vesicles with bound phycobilisomes from Anabaena variabilis. Katoh, T.; Gantt, E. (Smithsonian Institution, Rockville, MD). Contract EY-76-5-05-4310. *Biochim. Biophys. Acta;* **546**: 383-393(1979).

Photosynthetically active vesicles with attached phycobilisomes from Anabaena variabilis, were isolated and shown to transfer excitation energy from phycobiliproteins to F696 chlorophyll (Photosystem II). The best results were obtained when cells were disrupted in a sucrose/phosphate/citrate mixture (0.3:0.5:0.3 M, respectively) containing 1.5% serum albumin. The vesicles showed a phycocyanin/chlorophyll ratio essentially identical to that of whole cells, and oxygen evolution rates of 250 μmol O_2/h per mg chlorophyll (with 4 mM ferricyanide added as oxidant), whereas whole cells had rates of up to 450. Excitation of the vesicles by 600 nm light produced fluorescence peaks (-196°C) at 644, 662, 685, 695, and 730 nm. On aging of the vesicles, or upon dilution, the fluorescence yield of the 695 nm emission peak gradually decreased with an accompanying increase and final predominant peak at 685 nm. This shift was accompanied by a decrease in the quantum efficiency of Photosystem II activity from an initial 0.05 to as low as 0.01 mol O_2/einstein (605 nm), with a lesser change in the V/sub max/ values. The decrease in the quantum efficiency is mainly attributed to excitation uncoupling between phycobilisomes and Photosystem II. It is concluded that the F685 nm emission peak, often exclusively attributed to Photosystem II chlorophyll, arises from more than one component with phycobilisome emission being a major contributor. Vesicles from which phycobilisomes had been removed, as verified by electron microscopy and spectroscopy, had an almost negligible emission at 685 nm.

38757 Ascites production in 9 rat strains. Douglas, E.G.; Hamada, Y.; McKearn, T.J. (Univ. of Chicago, IL). *J. Immunol. Methods;* **26**: 69-74(1979).

A simple, inexpensive, and rapid method for inducing large volumes of ascitic fluid in rats is described. The procedure involves intraperitoneal injections of Freud's adjuvant emulsion on alternate days. Antibody activity of the ascitic fluid approximates that found in the serum. Female rats consistently respond better than males. Members of all 9 strains of rats tested produced ascites using this procedure.

38758 Radical processes in lipids. A laser photolysis study of t-butoxy radical reactivity toward fatty acids. Small, R.D. Jr.; Scaiano, J.C.; Patterson, L.K. (Univ. of Notre Dame, IN). *Photochem. Photobiol.;* **29**: 49-51(1979).

Laser photolysis techniques have been used to measure the reactivity of t-butoxy radical (t-BuO') toward various fatty acids. Eight compounds varying both in number and in the configuration of olefinic bonds were examined. It has been found that the rate constant for hydrogen abstraction from these compounds by t-BuO' may be related to the number of secondary, allylic, and doubly allylic hydrogens in each molecule.

38759 Susceptibility of urokinase to affinity labeling by peptides of arginine chloromethyl ketone. Kettner, C.; Shaw, E. (Brookhaven National Lab., Upton, NY). *Biochim. Biophys. Acta;* **569**: 31-40(1979).

Pro-Gly-ArgCH_2Cl, a reagent corresponding to the C-terminal sequence generated in plasminogen on activation by urokinase (EC 3.4.99.26) and probably by other plasminogen activators, was prepared. Pro-Gly-ArgCH_2Cl was effective in the inactivation of urokinase at the 10^{-6} M level (K/sub i/ 68 μM and k_2 0.47 min^{-1}). In contrast, only a slow inactivation was obtained by 10^{-2} M N-tosyllysine chloromethyl ketone. Glu-Gly-ArgCH_2Cl, N,N-dimethylaminonaphthalene-5-sulfonyl-Glu-Gly-ArgCH_2Cl, and Ac-Gly-Gly-ArgCH_2Cl were more reactive than Pro-Gly-ArgCH_2Cl against urokinase by factors of 25, 6, and 3, respectively. The effectiveness of arginine chloromethyl ketones as affinity labels is highly dependent on binding in the S_2 and S_3 sites, thus sequence variations in the reagents exhibited differences in reactivity of up to four orders of magnitude. The most effective reagents had Gly in P_3. Ac-Gly-Gly-ArgCH_2Cl inactivates urokinase 50 times more rapidly than it does plasmin, thus providing a means of distinguishing the activity of plasmin from its activating protease whereas urokinase is almost inert to Ala-Phe-LysCH_2Cl, a reagent which inactivates plasmin at the 10^{-7} M level.

38760 Analytical techniques for cell fractions. XXIV. Isoelectric point standards for two-dimensional electrophoresis. Anderson, N.L.; Hickman, B.J. (Argonne National Lab., IL). *Anal. Biochem.;* **93**: 312-320(1979).

We have investigated the two-dimensional electrophoretic behavior of a number of proteins throughout the course of carbamylation induced by heating in urea solution. Stepwise charge changes occur which are apparently commensurate with the number of free amino groups in the protein. Characteristic changes also occur in the sodium dodecyl sulfate (SDS) electrophoretic mobility (SDS molecular weight) of some heavily carbamylated proteins, implying altered structure of SDS binding. A mixture of all carbamylation intermediates of a protein provides a simple solution to the problem of internal isoelectric point standardization in the two-dimensional electrophoretic technique of P.H. O'Farrell.

38761 Crystallization and preliminary electron diffraction study to 3.7 A of DNA helix-destabilizing protein gp32*I. Chiu, W.; Hosoda, J. (Univ. of California, Berkeley). *J. Mol. Biol.;* **122**: 103-107(1978).

A two-dimensionally large and thin crystal has been obtained from gp32*I, a proteolytically digested product of a DNA helix-destabilizing protein coded by gene 32 in bacteriophage T4. High-resolution electron diffraction patterns (~ 3.7 A) are recorded from both unstained and stained protein crystals embedded in glucose. The crystal is of orthorhombic space group with a = 62.9 A and b = 47.3 A.

38762 Enzymes from human fibroblasts for the repair of AP DNA. Linn, S.; Kuhnlein, U.; Deutsch, W.A. (Univ. of California, Berkeley). pp 199-203 of DNA repair mechanisms. New York, NY; Academic Press, Inc. (1978).

AP endonuclease activity from cultured human fibroblasts was resolved into two species by phosphocellulose chromatography with Km's for apurinic sites of 5 and 44 nM, respectively. The low Km species was not detected in extracts of Xeroderma pigmentosum group D cell lines XP5BE, XP6BE, or XP7BE. In assaying for the endonuclease activity by its ability specifically to bind apurinic DNA we resolved from the endonuclease activity a 120,000 dalton protein that also specifically binds to this DNA. The protein appears to have the ability to reinsert purines into the apurinic DNA residues.

38763 Effect of $Mg.CTP^{2-}$ and $Mg.GTP^{2-}$ on the 3' → 5' exonuclease activity of T5-induced DNA polymerase. Das, S.K.; Fujimura, R.K. (Univ. of Tennessee, Oak Ridge). Contract W-7405-ENG-26. *J. Carbohydr., Nucleosides, Nucleotides;* **5**: No. 5, 457-467(1978).

$Mg.CTP^{2-}$ and $Mg.GTP^{2-}$ inhibit the 3' → 5' exonuclease action by T5-induced DNA polymerase on natural DNA. $Mg.ATP^{2-}$ and $Mg.UTP^{2-}$ do not produce any effect when similar concentrations are used. Neither $Mg.CTP^{2-}$ nor $Mg.GTP^{2-}$ is utilized as substrate. The inhibition produced by these nucleotides seems to be template-specific and noncompetitive with respect to the DNA substrate.

38764 Concentration quenching in chlorophyll-a and relation to functional charge transfer in vivo. Gutschick, V.P. (Los Alamos Scientific Lab., NM). *J. Bioenerg. Biomembr.;* **10**: No. 5/6, 153-170(1978).

Chlorophyll-a in ordinary solvents exhibits concentration quenching. Dimeric chlorophyll is reasonably well confirmed as the quenching species, by a critical reanalysis of available data on concentration dependence and on spectral features, in ordinary solvents, and in several analogous quenching environments. This quenching in the dimer in vitro is somewhat less firmly analyzed as due to a new fast internal conversion. Much peripheral evidence supports transient charge transfer as the cause of internal conversion. The same evidence points to a strong similarity to functional charge transfer in vivo. The inability to extract P680 may be due to its conversion to a form resembling P700 by addition of water. A number of straightforward experiments are suggested to test these proposals. In particular, it is desirable to test for the existence of a vibronic perturbation (from a higher $n\pi$ state) in the dimer, as an alternative to charge transfer for explaining the observed internal conversion. Such a vibronic cause would raise interesting problems for phototrap function in vivo.

38765 Interaction of plasma high density lipoproten HDL/sub 2b/ (d 1.063-1.100 g/ml) with single-bilayer liposomes of dimyristoylphosphatidylcholine. Nichols, A.V.; Gong, E.L.; Forte, T.M.; Blanche, P.J. (Univ. of California, Berkeley). *Lipids;* **13**: No. 12, 943-950(1978).

Incubation of a major subfraction, HDL/sub 2b/(d 1.063-1.100 g/ml), with single-bilayer liposomes of dimyristoylphosphatidylcholine (DMPC) resulted in uptake of DMPC by the HDL/sub 2b/ and dissociation of lipid-free apolipoprotein A-I (apoA-I). In the presence of excess DMPC, the dissociated apoA-I was also incorporated with DMPC into discoidal complexes. Preliminary studies with model apoA-I-DMPC ciomplexes indicated that they also can interact with native HDL/sub 2b/ with the resultant transfer of their DMPC to HDL/sub 2b/ and the concomitant release of their apoA-I. After interaction of HDL/sub 2b/ with DMPC lipsomes, the DMPC-enriched HDL/sub 2b/ product showed a lower hydrated density and a larger particle size than the control HDL/sub 2b/. The molecular properties of the lipoprotein product suggest that stabilization of the apoA-I-depleted HDL/sub 2b/ probably occurred via substitution of DMPC for the apoA-I at the HDL/sub 2b) surface rather than by fusion of the apoA-I-depleted HDL/sub 2b/. The above interactions of HDL/sub 2b/ with single-bilayer liposomes and discoidal cpomplexes indicate pathways of phospholipid transfer relevant to the possible role of HDL in the metabolism of lipoprotein surface components in vivo.

38766 Mapping the three-dimensional structure of proteins by photochemical techniques. Jori, G.; Spikes, J.D. (Univ. of Utah, Salt Lake City). Contract EY-76-S-02-0875. *Photochem. Photobiol. Rev.;* **3**: 193-275(1978).

In this review an attempt was made to survey and interpret the literature on two aspects of the mapping of the three-dimensional structure of proteins by photochemical techniques, i.e., by photoaffinity labeling and by the use of uv radiation. Photoaffinity labeling is a relatively new technique that is presently being widely exploited as indicated by the large number of published reports over the past few years. The use of uv radiation in protein structure studies is a much older approach. However, there has also been a recent burst of activity in this field, probably as a result of the development of more sophisticated instrumentation, and from the use of selective quenchers and sensitizers in conjunction with uv radiation. Almost half of the papers included in this review were published in the last three years. It is inevitable that a review of such rapidly progressing areas of research will become dated in a short period. By the time this review is published, many of our suggestions for experiments as listed in the sections on future prospects will have been done. Thus, many of the present interpretations will have been superseded or will have been shown to be incorrect. However, this review may still serve as a useful summary of the information available up until early in 1977 when the literature survey was completed.

38767 Control of photosynthesis by CO_2: evidence for a bicarbonate-inhibited redox feedback in photosystem II. Barr, R.; Crane, F.L. (Purdue Univ., W. Lafayette, IN). *Proc. Indiana Acad. Sci.;* **85**: 120-128(1976).

The role of bicarbonate or CO_2 as a regulator of electron flow was studied in spinach chloroplasts. It was found that bicarbonate inhibited a proposed cyclic pathway around Photosystem II while stimulating the forward flow of electrons toward Photosystem I. Such behavior would result in increased rates of ATP and NADPH formation by the green plant. It was also found that in isolated chloroplasts other compounds, such as chelators, uncouplers, or any inhibitor of silicomolybdic acid reduction in a DCMU-insensitive pathway around PS II would increase the forward flow of electrons to Photosystem I, provided that the compound itself was not inhibitory of ferricyanide or dimethylbenzoquinone reduction in Photosystem II, or inhibited the $H_2O \rightarrow$ methyl viologen pathway which covers both photosystems. Bathocuproine in low concentrations (10 to 15 μg/ml) turned out to be a model compound in all respects.

38768 Electron paramagnetic resonance study of the binding of manganese to ribulose-1,5-diphosphate carboxylase. Inhibition by magnesium. Chu, D.K.; Chang, R.; Vickery, L.E. (Univ. of California, Berkeley). *Biochim. Biophys. Acta;* **334**: 438-441(1974).

Electron paramagnetic resonance (EPR) was used to measure the extent of binding of Mn^{2+} to ribulose-1,5-diphoshate carboxylase purified from spinach leaves. In the Mn^{2+} concentration range 0.60 to 0.04mM three Mn^{2+} binding sites having K/sub d/ = 0.06 mM were observed. Mg^{2+} was found to competitively inhibit the binding of Mn^{2+}, and K/sub d/ = 0.54 mM was calculated for Mg^{2+}.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 38738, 38823, 38876

38769 α-bungarotoxin binding properties of a central nervous system nicotinic acetylcholine receptor. Lukasiewicz, R.J.; Bennett, E.L. (Univ. of California, Berkeley). *Biochim. Biophys. Acta;* **544**: 294-308(1978).

High-affinity, specific binding of radiolabeled α-bungarotoxin to particulate fractions derived from rat brain shows saturability (B/sub max/ ≅ 37fmol/mg, K/sub D//sup app/ = 1.7 nM) and insensitivity to ionic strength, and is essentially irreversible (K/sub on/ = 5 x 10^6 min^{-1} x mol^{-1}; K(displacement) = 1.9 x 10^{-4} min^{-1}, tau/sub 1/2/ = 62 h). Subcellular distribution of specific sites is consistent with their location on synaptic junctional complex and post-synaptic membranes. These membrane-bound binding sites exhibit unique sensitivity to cholinergic ligands; pretreatment of membranes with cholinergic agonists (but not antagonists) induces transformation of α-bungarotoxin binding sites to a high affinity form toward agonist. The effect is most marked for the natural agonist, acetylcholine. These results strongly support the notion that the entity under study is an authentic nicotinic acetylcholine receptor.

38770 A cis-active regulatory gene in the mouse: direct demonstration of cis-active control of the rate of enzyme subunit synthesis. Bernstine, E.G.; Koh, C. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Proc. Natl. Acad. Sci. U.S.A.;* **77**: No. 7, 4193-4195(Jul 1980).

Mouse mitochondrial malic enzyme [L-malate:$NADP^+$ oxidoreductase (oxaloacetate-decarboxylating), EC1.1.1.40] is a tetrameric protein. Two alleles of the structural gene (Mod-2) are known which code for electrophoretically distinct enzyme subunits: Mod-2/sup a/ and Mod-2/sup b/. A regulatory gene (Mdr-1), closely linked to Mod-2 on chromosome 7, determines the rate of mitochondrial malic enzyme synthesis in brain. Two alleles of Mdr-1 are known: Mdr-1/sup a/ (high activity) and Mdr-1/sup b/ (low activity). By pulse-labeling with [^{35}S]methionine, immune precipitation, and isoelectric focusing under dissociating conditions, we have measured the relative rates of synthesis of the two types of enzyme subunit in animals of genotypes Mdr-1/sup a/ Mod-2/sup a//Mdr-1/sup a/ Mod-2/sup b/ and Mdr-1/sup a/ Mod-2/sup a//Mdr-1/sup b/ Mod-2/sup b/. The results show that in the former animals both types of subunit are made at an identical rate, whereas in the latter animals the Mod-2/sup a/ gene product is synthesized at a rate 2.2 times that of the Mod-2/sup b/-coded subunit. Thus we have unambiguously demonstrated that Mdr-1 is cis-active in its control of the expression of the Mod-2 structural gene.

38771 Self-assembled chlorophyll a systems as studied by californium-252 plasma desorption mass spectroscopy. Hunt, J.E. (Texas A and M Univ., College Station); MacFarlane, R.D.; Katz, J.J.; Dougherty, R.C. *Proc. Natl. Acad. Sci. U.S.A.;* **77**: No. 4, 1745-1748(Apr 1980).

Self-assembled chlorophyll a and pheophytin a systems in thin solid films have been studied by ^{252}Cf plasma desorption mass spectrometry (PDMS). The ^{252}Cf-PDMS spectra of these films show monomer cation and anion molecular ions, ions of molecular aggregates, and positive and negative ion fragmentation patterns arising from the loss of various aliphatic side chains from the chlorin ring. Oligomer ions extending upwards in size to the heptamer were detected in this system.

38772 Analysis of proteins of mouse sarcoma pseudotype viruses: type-specific radioimmunoassays for ecotropic virus p30's. Kennel, S.J.; Tennant, R.W. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *J. Virol.;* **30**: No. 3, 729-734(Jun 1979).

Murine sarcoma virus pseudotypes were prepared by infection of nonproducer cells (A1-2), which were transformed by the Gazdar strain of mouse sarcoma virus, with Gross (N-tropic),WN1802B (B-tropic, or Moloney (NB-tropic) viruses. The respective host range pseudotype sarcoma viruses were defined by the titration characteristics on cells with the appropriate Fv-1 genotype. Proteins from virus progeny were analyzed by sodium dodecyl sulfate-polyacrylamide gel electrophoresis. Bands present in both the 65,000- and the 10,000- to 20,000-molecular-weight regions of the gel distinguished the pseudotype viruses from their respective helpers. Furthermore, two protein bands were noted in the p30 region of murine sarcoma virus (Gross), one corresponding to Gross virus p30, and another of slightly slower mobility. However, since the mobility of the putative sarcoma p30 is nearly indentical to that of WN1802B, its presence could not be established by sodium dodecyl sulfate-polyacrylamide gel electrophoresis. Type-specific radioimmunoassays for Gross virus p30 and for WN1802B p30 were applied for analysis of pseudotype preparations, and among several ecotropic viruses tested, only the homologous virus scored in the respective assay. By use of these assays, pseudotype viruses were found to contain only 8 to 48% helper-specific p30's; the remainder is presumably derived from the sarcoma virus.

38773 Origin of the multiple forms of alcohol dehydrogenase from Drosophila melanogaster. Schwartz, M.; O'Donnell, J.; Sofer, W. (Johns Hopkins Univ., Baltimore, MD). Contract EY-76-S-02-2965. *Arch. Biochem. Biophys.;* **194**: No. 2, 1-15(May 1979).

The three forms of alcohol dehydrogenase (EC 1.1.1.1) within a given strain of Drosophila melanogaster are composed of similar, if not identical, peptide chains as shown by amino acid analysis and peptide fingerprinting. After feeding [carbonyl-^{14}C]nicotinamide to flies, label is associated with only two of the three forms in the ratio 1:2. Similarly, a fluorescent compound is associated with the same two forms. After purification of this compound and characterization of it by thin layer chromatography and mass spectroscopy, we conclude that the multiple forms of Drosophila alcohol dehydrogenase appear to be caused by the noncovalent binding of 1 and 2 mol of an NAD-carbonyl compound addition complex to the enzyme.

38774 Processiveness of DNA polymerases: a comparative study using a simple procedure. Das, S.K.; Fujimura, R.K. (Univ. of Tennessee, Oak Ridge). Contract W-7405-ENG-26. *J. Biol. Chem.;* **254**: No. 4, 1227-1232(25 Feb 1979).

In this communication, we describe a simple procedure for analyzing the processiveness of DNA polymeriases in general. By choosing conditions for which the number of incorporations per available primer is < 1, we have reduced the probability of a primer molecule being utilized by the enzyme more than once. The primer-template used was poly(dA)$_{800}$:oligo(dT)$_{10}$, and the product was isolated by oligo(dT)-cellulose chromatography. The number of dTMP residues added per association was determined from the [^{3}H]dThd + [3'-^{3}H]dTMP/[^{3}H]dThd ratio of the product after its digestion by micrococcal nuclease and spleen phosphodiesterase. Using this procedure, we have found that Escherichia coli DNA polymerase I, T4 DNA polymerase, and calf thymus α- and β-DNA

polymerase are quasi-processive. Most of these enzymes add on the average ~ 10 to 15 nucleotides before dissociating from the template. T5 DNA polymerase, on the other hand, is processive, i.e., it continues to replicate a given template until it is very close to the 5' end of the template. With nicked DNA-like poly(dA):oligo(dT), the processiveness of E. coli DNA polymerase I is increased 2- to 2.5-fold. The significance of this increase in determining the patch size during DNA repair is discussed.

38775 ^{13}C nuclear magnetic resonance study of the CO_2 activation of ribulosebisphosphate carboxylase from Rhodospirillum rubrum. O'Leary, M.H. (Univ. of Wisconsin, Madison); Joworski, R.J.; Hartman, F.C. Contract W-7405-ENG-26. *Proc. Natl. Acad. Sci. U.S.A.;* **76**: No. 2, 673-675(Feb 1979).

Ribulosebisphosphate carboxylase [3-phospho-D-glycerate carboxy-lyase (dimerizing), EC 4.1.1.39] from Rhodospirillum rubrum is activated by CO_2 and Mg^{2+}. ^{13}C NMR spectra were determined for the unactivated enzyme and for enzyme that had been activated by $^{13}CO_2$ and Mg^{2+}. In addition to the expected resonance for $H^{13}CO_3^-/CO_3^{2-}$ at 161.8 ppM downfield from tetramethylsilane, the spectrum of the activated enzyme shows a broad resonance at 164.9 ppM. Analogy with previous NMR studies of $^{13}CO_2$ binding to hemoglobin suggests that the CO_2 activation of ribulosebisphosphate carboxylase involves formation of a carbamate between an enzyme amino group and CO_2.

38776 Evidence for a 5' → 3' direction of hydrolysis by a 5' mononucleotide-producing exoribonuclease from Saccharomyces cerevisiae. Stevens, A. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Biochem. Biophys. Res. Commun.;* **86**: No. 4, 1126-1132(1979).

[^{3}H]rRNA labeled at the 5' terminus with ^{32}P and [^{3}H]rRNA labeled at the 3' end with [^{14}C] (pA)/sub n/ have been degraded at 0° with a highly purified exoribonuclease from Saccharomyces cerevisiae. The results show that with the [^{32}P, ^{3}H] substrate, the ^{32}P label is rendered acid-soluble at a much faster rate than the ^{3}H label. Both acid-soluble labels are found in 5' mononucleotide. With the [^{14}C, ^{3}H] rRNA, the ^{3}H label is hydrolyzed at a faster rate than the ^{14}C label. The exoribonuclease hydrolyzes in the 5' → 3' direction.

38777 Inactivation of the plasminogen activator from HeLa cells by peptides of arginine chloromethyl ketone. Coleman, P.; Kettner, C.; Shaw, E. (Brookhaven National Lab., Upton, NY). *Biochim. Biophys. Acta;* **569**: 41-51(1979).

The binding specificities of human urinary urokinase (EC 3.4.99.26) and HeLa cell plasminogen activator were studied using peptidyl chloromethyl ketone inhibitors. A ^{125}I-labeled fibrin assay has been developed to yield kinetic information. Reagents of the sequence X-Gly-ArgCH_2Cl were the most effective. The susceptibility of the HeLa cell plasminogen activator differed from that of urokinase in several respects indicating the utility of this type of inhibitor in distinguishing between proteases of this specificity.

38778 Crotoxin effects on Torpedo californica cholinergic excitable vesicles and the role of its phospholiphase A activity. Hanley, M.R. (Univ. of California, Berkeley). *Biochem. Biophys. Res. Commun.;* **82**: No. 1, 392-401(15 May 1978).

The phospholipolytic neurotoxin from Crotalus durissus terrificus, crotoxin, is able to produce a dose- and time-dependent block of carbachol-stimulated ^{22}Na efflux from pre-loaded Torpedo californica excitable vesicles. The blocking activity is dependent on calcium and is abolished by chemical modification with p-bromophenacyl bromide. The isolated basic subunit, crotoxin B, produces an identical block, whereas the isolated acidic subunit, crotoxin A, has no detectable effect. Neither crotoxin nor crotoxin B antagonizes the binding of [^{125}I]-α-bungarotoxin to purified acetylcholine receptor, although, at high concentrations, they antagonize its binding to acetylcholine receptor-rich membrane fragments. Certain phospholipase A_2 enzymes and the fatty acid products of their digestion can mimic the crotoxin action. It is therefore suggested that, although considered a pre-synaptic neurotoxin, crotoxin can have in vitro post-synaptic effects, possibly mediated by its endogeneous phospholipase A_2 activity.

38779 Guanase in reticulocytes and other rat tissues. Hindman, H.B.; Knox, W.E. (Harvard Medical School, Boston, MA). *Enzyme;* **23**: 395-403(1978).

A sensitive and precise assay of guanase was based on the conversion of ^{14}C-guanine to uric acid in the presence of excess xanthine oxidase. The enzyme was entirely soluble in rat tissues and no inhibitors of it were detected. The most active tissues were red blood cells, lung and lactating mammary gland, with more than twice the activity of liver. The contained blood could account for the low activity in adult skeletal muscle and some other tissues. All fetal tissues examined were without activity. Activity in mammary gland rose fourfold during lactation and dropped precipitously during involution, with a secondary rise associated in time with the loss of cells from the gland. Reticulocytes present normally and after hemorrhagic anemia appeared to account for substantially all of the high guanase activity in red blood cells. The guanase level could be used to predict the degree of reticulocytosis in rats within confidence limits of +- 0.2%. The virtual absence of guanase in human red cells was confirmed, even in bloods containing elevated reticulocyte numbers.

CYTOLOGY

REFER ALSO TO CITATION(S) 38739, 38741, 38742, 38748, 38796, 38799, 38805, 38810, 38816, 38817, 38819, 38830, 38831, 38839, 38847, 38849, 38853, 38854, 38872

38780 Species variation in BrdUrd-induced sister-chromatid exchanges. McFee, A.F.; Sherrill, M.N. (Comparative Animal Research Lab., Oak Ridge, TN). Contract EY-76-C-05-0242. *Mutat. Res.;* **62**: 131-138(1979).

Peripheral blood lymphocytes from cattle, pigs, sheep and humans were cultured in the presence of 0.5, 1, 2, 5, 10 or 20 μg/ml of BrdUrd. Sister-chromatid exchanges were scored in 25 second-division metaphases from each donor at each level of the chemical. Dose-response curves for all 4 species increased steeply to 2 μg/ml; above this level, SCE numbers increased less rapidly but maintained a linear relationship to increasing BrdUrd concentration. Comparisons of the straight-line portions of the dose-response curves showed human cells to be significantly more sensitive to increasing BrdUrd level than cow or pig cells and different from sheep at the 10% level of confidence.

38781 Hemopoietic stem cell heterogeneity: use of cell cycle-specific drugs to look for age-associated alterations. Popp, D.M.; Popp, R.A. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Mech. Ageing Dev.;* **9**: 441-462(1979).

Hemopoietic tissue is vulnerable to perturbations, and data show that it is an appropriate tissue in which to look for age-associated alterations. This tissue has a high regenerative capacity, is composed of a heterogeneous population of stem cells that are capable of self renewal or differentiation, or both, and is sustained by a pool of resting cells. The heterogeneity of bone marrow has made characterization of the cellular elements difficult. Techniques commonly used to identify and quantify the various maturation levels of hemopoietic stem cells and the limitations of these techniques are discussed. Most techniques used to assay age-associated changes in bone marrow have not differentiated between specific cellular alterations or shifts in the distribution of the cellular elements. In particular, it has been difficult to determine the stability of the non-dividing stem cell because of the low incidence of this cell (6 per 1000) and the lack of a specific assay for this important cell type. The use of cell cycle-specific drugs has provided quantitative information on specific subpopulations of hemopoietic stem cells and seems to be the most promising approach towards determining qualitative and quantitative differences in the hemopoietic stem cells of young and old individuals.

38782 Effect of indicator layer thickness on the interpretation of hemolytic plaque results. Goldstein, B.; Perelson, A.S. (Los Alamos Scientific Lab., NM). *Mol. Immunol.;* **16**: 395-400(1979).

Mathematical theories of hemolytic plaque growth have all previously assumed that the assay is performed in layers of infinite thickness or in layers sufficiently thin that diffusion perpendicular to the layer can be neglected. Here we discuss the results of a general theory valid for any layer thickness and show under what conditions the approximate results for two-dimensional or infinitely thick layers apply. In commonly used procedures the thickness h can vary more than six hundred fold, i.e., 1×10^{-3}cm ≦ h ≦ 6.5×10^{-1}cm. We show that such variation in h will cause significantly different kinetics of plaque growth and change the sensitivity of the plaque assay. We establish that for typical direct plaque experiments of one hour duration the two-dimensional limit will be valid when h ≦ 3×10^{-3} cm, whereas the infinite thickness results will be valid when h > 10^{-1}cm. For intermediate thicknesses the interpretation of plaque results is considerably more difficult and this range of layer thickness should be avoided if one is interested in doing more than simply counting plaque forming cells. For the limiting cases of very thin and very thick layers we compare the expected time development of a plaque, we compute the number of antibodies needed to produce a detectable plaque, and establish the range of times for which the plaque growth follows the limiting mathematical solutions. At very short times all layers appear thick while at long times all layers appear thin.

38783 Pressure-controlled CO_2-air system for animal cell culture. Snipes, W.; Coohill, T.; Person, S.; Keller, G. (Pennsylvania State Univ., University Park). *TCA Man.;* **4**: No. 4, 917-920(1978).

The bicarbonate buffering sytem used in most cell culture media requires a source of air containing a prescribed concentration of CO_2 (usually 5% to 10%). This CO_2-air mixture is obtained either by mixing streams of air and 100% CO_2 in suitable proportions or by

using premixed gas from a commercial source. Controls to regulate the flow of CO_2 and air are standard equipment on many commercial incubators designed for cell-culture laboratories. Culture growing in petri dishes or bottles with loose caps are gassed by diffusion of the CO_2-air mixture that fills the interior of the incubator. An inherent problem with such systems is that frequent opening of the incubator door depletes the CO_2-air mixture inside, and cultures may suffer from inconstant environmenal CO_2 concentrations. In our laboratories we utilize a CO_2-air system in which the gases are mixed by pressure rather than flow rate. The mixture is stored under pressure and delivered at low pressure, using gum-rubber tubing, to incubators and warm rooms. Outlets in the incubators and warm rooms are connected to individual plastic boxes, each box containing the plates or bottles for a single experiment. Thus the incubators and warm rooms do not require a CO_2-air environment. An auxiliary outlet of this CO_2 supply with a separate pressure regulator is used for pressurized filtration of tissue-culture media. Outlets to transfer hoods are used to flush, rubber-lined, screw-capped bottles prior to incubation. This paper describes the construction and operation of such a system and discusses some of its features in relation to the conventional flow-rate mixing systems.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 38779, 38792

GENETICS

REFER ALSO TO CITATION(S) 38747, 38780, 38826, 38835, 38850, 38869

38784 Probing the component structure of a maize gene with transposable elements. Kermicle, J.L. (Univ. of Wisconsin, Madison). Contract-EY-76-S-02-1300. *Science;* **208**: 1457-1459(27 Jun 1980).

Three instances of R gene instability were found in maize stocks carrying the controlling elements Dissociation (Ds) and Modulator (Mp). In each, Ds or a Ds-like element had transposed to R, inhibiting kernel pigmentation irregularly. When Mp was removed from the genome, R expression stabilized at low to intermediate levels. Strong pigmenting action was restored through recombination in heterozygotes of three new forms with an R allele that specifies only plant pigmentation. The sites of Ds insertion mapped distal to the region that specifies seed versus plant expression. The evidence suggest that an R functional unit consists of one component that both governs tissue-specific expression and another that is common to alleles of different tissue-specific activities.

38785 Chromosomal DNA cytophotometry in 20q: nonspecific myeloid disorders. Carrano, A.V.; Mayall, B.H.; Testa, J.R.; Ashworth, L.K.; Rowley, J.D. (Univ. of California, Livermore). Contract W-7405-ENG-48;EY-76-C-02-0069. *Cancer Res.;* **39**: 2984-2987(Aug 1979).

DNA cytophotometry was used to quantify the chromosomal alterations in the bone marrow and blood of three patients with nonspecific myeloid disorders. All patients possessed a population of cells with a morphologically abnormal chromosome 20, del(20)(qll). In two of the patients, the abnormal chromosome 20 showed nearly identical DNA measurements with a net loss of 0.37% of the total autosomal DNA in one patient and 0.38% in the second. The third patient had a net loss of only 0.25% of the autosomal DNA. Analysis of the DNA content of the long arm and short arm of the abnormal No. 20 indicated that all three cases had chromosomal material added to the short arm (0.10 to 0.14% of the autosomal DNA). About 0.50% of the autosomal DNA was deleted from the long arm in two of the patients; only 0.35% of the autosomal DNA was deleted from the long arm in the third case. Within the limit of resolution, there is no evidence that the material lost has been translocated intact to another chromosome. The origin of the 20q- chromosome as the result of an incomplete pericentric inversion is suggested.

38786 Genetic lesions induced by chemicals in spermatozoa and spermatids of mice are repaired in the egg. Generoso, W.M.; Cain, K.T.; Krishna, M.; Huff, S.W. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Proc. Natl. Acad. Sci. U.S.A.;* **76**: No. 1, 435-437(Jan 1979).

Conclusive proof that the mouse egg is capable of carrying out repair of genetic lesions present in the male genome was obtained through dominant-lethal studies of chemically treated spermatozoa and spermatids and through cytological analysis of first-cleavage metaphases. The maximum difference in repair capability between stocks of females, found for isopropyl methanesulfonate treatment, was large; considerably smaller differences were found for ethyl methanesulfonate, triethylenemelamine, and benzo[a]pyrene treatments; and no difference was found for x-ray treatment.

38787 Physical mapping and characterization of the mitochondrial DNA and RNA sequences from mit⁻ mutants defective in cytochrome oxidase peptide 1 (OXI 3). Morimoto, R.; Lewin, A.; Rabinowitz, M. (Univ. of Chicago, IL). Contract EY-76-C-02-0069. *Mol. Gen. Genet.;* **170**: 1-9(1979).

Yeast mitochondrial mutants defective in cytochrome c oxidase have been isolated and genetically characterized by Slonimski and Tzagoloff. Three genetic loci, designated OXI 1, OXI 2, and OXI 3, each affect the synthesis of a separate mitochondrially coded subunit of cytochrome oxidase. We have analyzed the mitochondrial DNA and RNA of mutants with defects at the locus which impair the synthesis of the 43,000 subunit I peptide, in order to map the structural gene and identify the RNA species transcribed from this region.

38788 Physical mapping of the Xba I, Hinc II, Bgl II, Xho I, Sst I, and Pvu II restriction endonuclease cleavage fragments of mitochondrial DNA of S. cerevisiae. Morimoto, R.; Rabinowitz, M. (Univ. of Chicago, IL). Contract EY-76-C-02-0069. *Mol. Gen. Genet.;* **170**: 11-23(1979).

A detailed molecular dissection of the yeast mitochondrial genome can be made with restriction endonucleases that generate site-specific cuts in DNA. The ordering of restriction fragments provides the basis of the physical mapping of mitochondrial transcripts and antibiotic resistance (ant/sup R/) loci, and is a means of analyzing the molecular organization of mtDNA of petite and mit⁻ deletion mutants. We have previously mapped the sites in the mtDNA of yeast strain MH41-7B recognized by the endonucleases Eco RI, Hpa I, Hind III, Bam HI, Sal I, Pst I, and Hha I, providing a total of 41 cleavage sites. We have now mapped the sites recognized by the endonucleases Xba I, Hinc II, Bgl II, Pvu II, Xho I, and Sst I, which make 6, 13, 5, 6, 2, and 2 cuts, respectively. Fragment maps for each of these endonuclease sites were derived by analysis of the products of double-enzyme digests and by hybridization of ^{3}H-cRNA probes transcribed from low-kinetic-complexity petite mtDNAs to restriction fragments generated by various combinations of enzymes.

38789 Mouse albumin mRNA in liver and a hepatoma cell line. Brown, P.C.; Papaconstantinous, J. (Univ. of Tennessee, Oak Ridge). Contract W-7405-ENG-26. *J. Biol. Chem.;* **254**: No. 12, 5177-5183(1979).

Albumin, a major serum protein synthesized and secreted by the liver, is one of several serum proteins whose synthesis is regulated by hormonal and nutritional factors as well as during liver development. As a part of our studies on the regulation of serum protein synthesis, we have isolated mouse albumin mRNA by direct immunoprecipitation of albumin-synthesizing polysomes and oligo(dT)-cellulose chromatography of albumin polysomal RNA. This albumin mRNA sediments at about 17 S, which corresponds to a molecular weight of approximately 6.5×10^5 or 2000 nucleotides. Translation in vitro yielded a product which is immunoprecipitable with anti-mouse albumin and which showed a single radioactive peak having a molecular weight of 68,000 on sodium dodecyl sulfate-polyacrylamide gel electrophoresis. DNA, complementary to albumin mRNA, was synthesized with avian myeloblastosis virus RNA-dependent DNA polymerase. This complementary DNA was shown by alkaline sucrose density gradient sedimentation to have a molecular weight of 5.3×10^5 which is equivalent to 1740 nucleotides and represents approximately 87% of the total 17 S mRNA. Hybridization of the cDNA to its template mRNA gave a R_0t/sub 1/2/ value of 2.3×10^{-3} mol nucleotides.s.liter^{-1} (in 0.5 M NaCl). The resultant cDNA-mRNA hybrid displayed a melting temperature of 89°C when analyzed by thermal elution from a hydroxylapatite column,indicating a high degree of fidelity of the base pairings formed in this hybrid. Data from the hybridization analyses and cell-free translation studies indicate that the albumin mRNA is about 80 to 85% pure. Quantitation of albumin mRNA in total cytoplasmic RNA, by hybridization of cDNA under conditions of RNA excess, revealed that mouse liver contains about 10-fold more albumin mRNA sequences than Hepa-2 cells, a permanent mouse hepatoma cell line that has maintained the capacity to synthesize albumin.

38790 Chromosome 14 translocations in non-Burkitt lymphomas. Fukuhara, S.; Rowley, J.D. (Univ. of Chicago, IL). Contract E4-76-C-02-0069. *Int. J. Cancer;* **22**: 14-21(1978).

Chromosome studies were performed on malignant cells obtained from 27 patients with non-Burkitt lymphomas. A marker chromosome affecting the long arm of No. 14 (14q+) was the single most frequent abnormality and was noted in 17 of these patients. The frequency of the 14q+ marker varied with the type of lymphoma. For patients with malignant lymphoma, histiocytic, the frequency was 5 or 8; for mixed-cell type, 1 of 3; for poorly differentiated lymphocytic, 8 of 8; for well-differentiated lymphocytic, 0.3; for lymphoblastic, 0 of 1; for Hodgkin's disease, 2 of 3; and for mycosis fungoides, 1 of 1. The donor chromosome involved in the 14q translocation was identified in 12 cases; certain chromosomes appeared to be affected more frequently than others. Although the break point was band 14q32 in most cases, the exact location of the

receptor site on 14q was not always consistent. The distal part of 14q24 was also involved as a receptor site in at least one translocation. These findings suggest that, in some types of lymphoid malignancy, cells with a 14q translocation have a proliferative advantage over cells with other chromosome rearrangements. The presence of the 14q translocation may be important in the future for the distinction among morphologically different, but functionally comparable, subgroups of lymphoid malignancies.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 38770

38791 Physical mapping of the yeast mitochondrial genome: derivation of the fine structure and gene map of strain D273-10B and comparison with a strain (MH41-7B) differing in genome size. Morimoto, R.; Rabinowitz, M. (Univ. of Chicago, IL). Contract EY-76-C-02-0069. *Mol. Gen. Genet.;* **170**: 25-48(1979).

We have derived a fine-structure map of the 70 kb mitochondrial genome of the yeast S. cerevisiae, strain D273-10B, and compared it with our previous maps for strain MH41-7B. Restriction fragment maps for 56 enzyme recognition sites for 13 endonucleases, Eco RI, Hpa I, Bam HI, Hha I, Hinc II, Xba I, Hind III, Bgl II, Pvu II, Sal I, Pst I, Sst I, and Xho I, have been derived. We have used several methods to obtain these maps: (a) Four enzymes (Sal I, Sst I, Xho I, Pst I), each of which cuts D273-10B mtDNA at a single site, were employed to localize and orient fragments from multi-site enzyme digests that are cleaved by the single-site enzyme. (b) Radioactively labeled probes (rRNA or copy RNA[cRNA] transcribed from simple-sequence petite mtDNA) were hybridized to restriction fragments from different digests for identification of fragments which share common sequences. (c) The products of double or triple enzyme digests were identified for mapping and confirmation of the localization of restriction sites.

38792 Use of mouse x-autosome translocations in the study of x-inactivation pathways and nonrandomness. Russell, L.B.; Cacheiro, N.L.A. (Oak Ridge National Lab., TN). pp 393-416 of Genetic mosaics and chimeras in mammals. Russell, L.B. (ed.). New York, NY; Plenum Publishing Corp. (1978).

By means of autoradiographic study of an array of mouse x-autosome translocations with different breakpoints, we have demonstrated that, in each case, only one translocation product is subject to allocyclic behavior, and that there is thus no memory system. This finding, in conjunction with earlier evidence that degree of inactivation of translocated autosomal loci is influenced by breakpoint position, is most easily interpreted by assuming a single inactivation center, with polarity in both directions. Other interpretations require special assumptions. In short-term cultures from adult kidney of five T(X;7)'s there is nonrandomness in x-chromosome allocycly, with X/sup n/ predominantly (but not exclusively) inactive. This nonrandomness is not observed in two T(X;4)'s, nor does it occur in some fetal tissues of the (T(X;7)'s. We propose that a region of Chromosome 7 contains genetic material critical for growth or maintenance of kidney cells, and that inactivation of this region in T(X;7)'s results in tissue-specific selection. Translocations in which X/sup n/ exclusively is inactive are presumably extreme examples of selection resulting from autosomal inactivation.

METABOLISM

REFER ALSO TO CITATION(S) 38725, 38753, 38773, 38800, 38854, 38858, 38864, 38875

38793 Adjustable metabolism units for swine. Eisele, G.R.; Kopp, W.J. (Comparative Animal Research Lab., Oak Ridge, TN). Contract EY-76-C-05-0242. *Lab. Anim. Sci.;* **29**: No. 4, 538-541(Aug 1979).

A swine metabolism unit was constructed which permitted separate quantitative collection of urine and feces. The unit was built of wood and proved to be reliable. It was adapted for studies with goats, sheep and young cattle.

MEDICINE

REFER ALSO TO CITATION(S) 38785, 38818, 38832, 38833

38794 Alkyl phospholipid antihypertensive agent. Snyder, F.L.; Blank, M.L. (to Dept. of Energy). US Patent Application 092,156. [nd]. 23p.

The composition of this invention is 1-0-alkyl-2-acetoyl-sn-glycero-3-phosphocholine. The alkyl is a saturated alkyl having 9 to 21 carbon atoms, or salts or hydrates of the composition. Preferably the alkyl has 13 to 19 carbon atoms and most preferably 15 carbon atoms. The composition of this invention is useful for reducing hypertension in warm-blooded animals, including humans, when administered either orally or by injection or innoculation, e.g., intravenous injection. The composition can be prepared from naturally occurring lipids or synthetically from commercially available materials. The ionic structural formula is given.

38795 Rapid preparation of nucleotides from acid-soluble pools by chromatography on silica, as exemplified with acid extracts of cultured cells. Lothrop, C.D. Jr.; Uziel, M. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Clin. Chem.;* **26**: No. 10, 1430-1434(Sep 1980).

A rapid technique (5 to 10 min) has been developed for fractionating nucleotides from base and nucleoside contaminants in acid extracts of cells by adsorption to silica gels. More than 95% of the amounts of bases and nucleosides present, except for cytidine (92%), did not adsorb to silica. Nucleotides were then quantitatively eluted with water. The retention volumes for positive, negative, and neutral nucleic acid components have been determined to investigate the discriminatory properties of nucleic acid components on silica. This procedure has been used to purify nucleotides from several normal and transformed cell lines.

38796 Chronic myelodysplastic syndrome (preleukemia) with the Philadelphia chromosome. Roth, D.G.; Richman, C.M.; Rowley, J.D. (Univ. of Chicago, IL). Contract EY-76-C-02-0069. *Blood;* **56**: No. 2, 262-264(Aug 1980).

A patient with severe anemia, reticulocytopenia, and erythroid hyperplasia of the bone marrow developed fatal acute nonlymphocytic leukemia after 3 yr. A Philadelphia chromosome with the typical 9/22 translocation was identified by banding techniques in a small number of bone marrow cells throughout the preleukemic phase of the illness (14% to 38% of the metaphases) and during the acute transformation (50%). Granulocytic colony formation in vitro was abnormal in the preleukemic phase. The diagnosis of chronic granulocytic leukemia was excluded on the basis of clinical and laboratory findings. The identification of the Ph^1 chromosome in this form of chronic myelodysplastic syndrome (preleukemia) provides a new example of a hematologic disorder predisposing to acute leukemia in which this chromosomal abnormality occurs.

38797 Kinetics of granulocytopoiesis. Cronkite, E.P. Contract EY-76-C-02-0016. *Clin. Haematol.;* **8**: No. 2, 351-370(1979).

A large battery of tests for studying granulopoiesis have been presented and analysed, each having its own intrinsic merit. No single approach is adequate for the study of factors regulating proliferation and differentiation of CFU-S, CFU-C, or the recognizable granulocytic marrow. A test for measurement of the CFU-S in animals other than the mouse, and in particular in man, is urgently required.

38798 LOGIT: a program for dose-response analysis. Koshiver, J.; Moore, D. (Univ. of California, Livermore). Contract W-7405-ENG-48. *Comput. Programs Biomed.;* **10**: 61-65(1979).

We describe a FORTRAN computer program for fitting the logistic distribution function: P(x) = E/sup $\alpha + \beta$x//1 + e/sup $\alpha + \beta$x/. Where x represents dose or time, to dose-response data. The program determines both weighted least squares and maximum likelihood estimates for the parameters α and β. It also calculates the standard errors of α and β under both estimation methods, as well as the median lethal dose (LD_{50}) and its standard error. Dose-response curves found by both fitting methods can be plotted as well as the 95% confidence bands for these lines.

38799 Chromosome changes in leukemia. Rowley, J.D. Contract EY-76-C-02-0069. London, England; Leukaemia Research Fund (1978). 20p.

The cytogenetic analysis of leukemic cells from patients with a variety of leukemias has resulted in significant knowledge about the genetic constitution of these cells. A correlation of chromosome findings with clinical observations, combined with morphologic studies, has provided us with new diagnostic and predictive information. Thus, we now realize that a substantial proportion of patients with APL has a consistent translocation involving chromosomes No. 15 and 17. Moreover, the karyotype of patients with ANLL, particularly AML, is correlated with their response to treatment and with their survival. A task for the future is to correlate the karyotype with various other cellular markers so that we may gain more insight into the biologic significance of chromosome changes. The observation that a 14q + marker chromosome is associated with B-cell ALL is an example of such a correlation. In the future, we will obtain similar data on the way in which the specific chromosome changes in the acute phase of CML are related to cell surface markers (the presence of non-T, non-B ALL antigen, and TdT levels) and rsponse to various modalities of treatment. In the past, relatively few studies were done independently by various specialists on any single patient. Our present, and particularly our future emphasis will be on many sophisticated analyses carried out jointly on each patient. The correlation of the results of these studies will provide us with the insights

necessary to identify the different cells affected, and to gain a better understanding of the nature of the leukemogenic process.

UNSEALED RADIONUCLIDES IN DIAGNOSTICS

38800 Use of ^{13}C-phenacetin and ^{13}C-methacetin for the detection of alterations in hepatic drug metabolism. Schneider, J.F.; Schoeller, D.A.; Schreider, B.D.; Kotake, A.N.; Hachey, D.L.; Klein, P.D. pp 507-516 of Stable isotopes: proceedings of the third international conference. Chicago, IL; Univ. of Chicago ([nd]).

^{14}C-Phenacetin (labeled in the ethyl position), ^{14}C-methacetin, and ^{14}C-dimethyl aminopyrine were administred to rats orally and respiratory CO_2 was collected for timed intervals thereafter. A more rapid production of $^{14}CO_2$ was observed with both methacetin and phenacetin than with aminopyrine. Pre-treatment of rats with phenobarbital (40 mg/kg) for 4 days produced an increase in aminopyrine N-demethylation but not in methacetin O-dealkylation. Pretreatment with 3-methylcholanthren (20 mg in a single dose 2 days before testing) increased phenacetin O-dealkylation but not aminopyrine N-demethylation. In 4 normal human subjects, administration of ^{13}C-methacetin resulted in high levels of $^{13}CO_2$ in breath within 15 min. These values showed no overlap with the lower values obtained from 8 subjects with liver disease. The rates of appearance of label from N-demethylation of aminopyrine or from phenacetin O-dealkylation in the same subjects were equivalent for some patients with liver disease and for one normal subject. Smokers had a significantly greater rate of O-dealkylation of methacetin than did non-smokers, but had similar rates of aminopyrine N-demethylation. Because of its more rapid metabolism in normal subjects and its lack of toxicity in small doses, ^{13}C-methacetin may be preferable to aminopyrine for measurement of hepatic microsomal function in man. ^{13}C-methacetin could be used in detection of environmental exposure to polycyclic hydrocarbons.

38801 Imaging experimental infective endocarditis with indium-111-labeled blood cellular components. Riba, A.L.; Thakur, M.L.; Gottschalk, A.; Andriole, V.T.; Zaret, B.L. (Yale Univ. School of Medicine, New Haven, CT). Contract EY-76-S-02-4078. *Circulation;* **59**: No. 2, 336-343(Feb 1979).

The capability of radionuclide imaging to detect experimental aortic valve infective endocarditis was assessed with indium-111 (^{111}In)-labeled blood cells. Sequential cardiac imaging and tissue distribution studies were obtained in 17 rabbits with infective endocarditis after administration of ^{111}-In-platelets and in five after ^{111}In-polymorphonuclear leukocytes. Forty-eight to 72 hours after platelet administration, in vivo imaging demonstrated abnormal ^{111}In uptake in all animals in the region of the aortic valve in an anatomically distinct pattern. Images of the excised heart showed discrete cardiac uptake conforming to the in vivo image and gross pathological examination. ^{111}In platelet uptake in vegetations from the 17 animals averaged 240 +- 41 times greater than that in normal myocardium and 99 +- 15 times greater uptake in blood. In contrast, ^{111}In-leukocyte cardiac imaging showed no abnormal aortic valve uptake 24 hours after tracer administration and the lesion myocardium activity ratio was only 5 +- 2 (3 +- 1 for lesion/blood activity). Four normal rabbits demonstrated neither positive ^{111}In platelet scintigraphs nor abnormal cardiac tissue uptake. Likewise, noncellular ^{111}In was not concentrated to any significant extent in three animals with infective endocarditis.This study demonstrates that ^{111}In platelet, but not leukocyte cardiac imaging, is a sensitive technique for detecting experimental infective endocarditis. The imaging data conform to the cellular pathology of the infective endocarditis vegetation.

EXTERNAL RADIATION IN DIAGNOSTICS

REFER ALSO TO CITATION(S) 38621

38802 (BNL—27621) **Spectrometer system for investigation of biological molecules with synchrotron radiation at wavelengths greater than 125 nm.** Takacs, P.Z.; Sutherland, J.C. (Brookhaven National Lab., Upton, NY (USA)). Apr 1980. Contract EY-76-C-02-0016. 5p. (CONF-800626—1). NTIS, PC A02/MF A01.

From 6. international conference on vacuum ultraviolet radiation physics; Charlottesville, VA, USA (2 Jun 1980).

The SUPERB experiment at the SURF II storage ring uses synchrotron radiation as a source of uv photons to measure circular dichroism (CD) of biological molecules. Conventional CD instruments are limited by the lack of stable laboratory continuum sources capable of providing large photon fluxes shortward of 200 nm. Synchrotron radiation overcomes these limitations and enables one to extend CD measurements down to the limit of the window transmission cutoff, which is 125 nm for CaF_2 used in the present configuration. Some molecules of biophysical interest, DNA and proteins for example, exhibit large CD effects below 200 nm, which reflect specific molecular conformations. CD is a sensitivie probe of molecular structure and enables us to learn how these molecules behave under various external conditions. In the future we plan to increase the measurement capabilities of SUPERB to include magnetic circular dichroism, fluorescence spectroscopy, and fluorescence lifetime measurements.

38803 Proceedings of radiological health symposium. Contract EY-76-C-02-0069. Chicago, IL; University of Chicago (1979). 26p.

From Bureau of Radiological Health symposium; Oak Ridge, TN, USA (Jun 1979).

Resolution (or sharpness) of radiographic screen-film systems influences the physical image quality of radiographs, and thereby the diagnositc accuracy and patient exposure. We use the modulation transfer function (MTF) to quantify the resolution property of screen-film systems. In our laboratory, the slit method and the digital Fourier transformation are used for measurements of the MTFs of screen-film systems. Recent measurements indicate that the MTFs of Detail, Par Speed, and Hi-Plus screens with XRP film are significantly lower than the MTFs of the same screens with Blue Brand film. This result underscores the need to evaluate the resolution property of screen-film systems with close attention to the x-ray film used.

EXTERNAL RADIATION IN THERAPY

REFER ALSO TO CITATION(S) 38833, 38834, 38836, 38837

38804 Localization of structures for pion radiotherapy by computerized tomography and orthodiagraphic projection. Tsujii, H.; Bagshaw, M.A.; Smith, A.R.; von Essen, C.F.; Mettler, F.A.; Kligerman, M.M. (Univ. of New Mexico, Albuquerque). *Int. J. Radiat. Oncol., Biol. Phys.;* **6**: No. 3, 319-325(Mar 1980).

Clinical trials of pion radiotherapy are being conducted at the Clinton P. Anderson Meson Physics Facility (LAMPF) in Los Alamos. For pion treatment planning, computerized tomography (CT) is used for three-dimensional localization of tumor and critical normal structures and for corrections for tissue inhomogeneities. Techniques that make anatomical information on CT scans directly transferable to therapy planning are described, as well as a technique for taking simulation and verification portal films using orthodiagraphic projection. Several requirements for direct use of CT scans in pion treatment planning are discussed. Finally, the effects of patient positioning on organ and tumor mobility and tissue inhomogeneity as shown by CT images are demonstrated.

38805 Increase in immunogenicity with concomitant loss of tumorigenicity of respiratory tract carcinomas during in vitro culture. Jamasbi, R.J. (Iran School of Medicine amd Medical Sciences, Tehran); Nettesheim, P. Contract W-7405-ENG-26. *Cancer Res.;* **39**: 2466-2470(Jul 1979).

Cell lines were established in vitro from respiratory tract carcinomas induced in rats by carcinogenic, polycyclic hydrocarbons. Propagation of the carcinoma lines in vitro lead to a progressive decrease in tumorigenicity. Tumor transplantation studies in x-irradiated, immunosuppressed recipients and in immunologically reconstituted recipients suggested that the cells are rejected because of their immunogenicity, since a high incidence of tumors was observed in x-irradiated recipients but not in normal or x-irradiated, reconstituted recipients. When immunologically competent rats were immunized with cells from an in vitro tumor line, strong tumor transplantation resistance resulted. Similar immunization with the corresponding in vivo tumor line caused very little if any protection, and immunization with a non-cross-reacting sarcoma line grown in vitro did not produce immunological protection against carcinoma cell lines. A single in vivo passage of the in vitro-adapted tumor line in immunosuppressed recipients fully restored tumorigenicity. The increase in immunogenicity of carcinomas cultured in vitro appears to involve preexisting antigens indigenous to the carcinomas rather than new antigens acquired during tissue culture, such as antigens related to retroviruses, mycoplasmas, or heterologous serum.

UNSEALED RADIONUCLIDES IN THERAPY

REFER ALSO TO CITATION(S) 38836

MICROBIOLOGY

REFER ALSO TO CITATION(S) 37628, 37785, 38737, 38745, 38747, 38753, 38756, 38787, 38788, 38811, 38813, 38859

38806 (CONF-800739—2(Draft)) **Tapered fluidized bed bioreactor for environmental control and fuel production.** Scott, C.D.; Hancher, C.W.; Arcuri, E.J. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 11p. NTIS, PC A02/MF A01.

From 6. international fermentation symposium and 5. international symposium on yeasts; London, Ontario, Canada (20 Jul 1980).

Fluidized bed bioreactors are under development for use in environmental control and energy production. The most effective

systems utilize a tapered portion either throughout the column or at the top of the column. This taper allows a wide range of operating conditions without loss of the fluidized particulates, and in general, results in more stable operation. The system described here utilize fixed films of microorganisms that have attached themselves to the fluidized particles. Preliminary investigations of the attachment indicate that reactor performance is related to film thickness. The biological denitrification of aqueous waste streams is typical of processes under development that utilize fluidized bed bioreactors. This development has progressed to the pilot plant scale where two 20-cm-diam x 800-cm fluidized beds in series accept aqueous wastes with nitrate concentrations as high as 10,000 mg/l and denitrification rates greater than 50 g/l/day using residence times of less than 30 minutes in each reactor. Other applications include aerobic degradation of phenolic wastes at rates greater than 25 g/l/day and the conversion of glucose to ethanol.

38807 Prevalence and distribution of Aeromonas hydrophila in the United States. Hazen, T.C. (Wake Forest Univ., Winston-Salem, NC); Fliermans, C.B.; Hirsch, R.P.; Esch, G.W. Contract AS09-76EV00900;AC09-76SR00001. *Appl. Environ. Microbiol.;* **36**: No. 5, 731-738(Nov 1978).

The abundance of Aeromonas hydrophila was measured in 147 natural aquatic habitats in 30 states and Puerto Rico. Viable cell counts were used to estimate density at all sites by using Rimler-Shotts medium, a differential presumptive medium for A. hydrophila. Temperature, pH, conductivity, salinity, and turbidity were measured simultaneously with water sample collection. The density of A. hydrophila was higher in lotic than in lentic systems. Saline systems had higher densities of A. hydrophila than did freshwater systems. A. hydrophila could not be isolated from extremely saline, thermal, or polluted waters, even though it was found over wide ranges of salinity, conductivity, temperature, pH, and turbidity. Of the water quality parameters measured, only conductivity was significantly regressed with density of A. hydrophila.

38808 Characterization of some pneumococcal bacteriophages. Porter, R.D.; Guild, W.R. (Duke Univ., Durham, NC). Contract AT-(40-1)-3941. *J. Virol.;* **19**: No. 2, 659-667(Aug 1976).

The growth of pneumococcal phages at high cell and phage densities is enhanced strongly by the substitution of potassium for sodium in the medium. Initial titers of 2 x 10^{10} to 4 x 10^{10} PFU/ml are readily obtained, and concentrated stocks are stable in a storage buffer described here. The mechanism of the cation effect is obscure. Phages ω3 and ω8 each have linear double-stranded DNA of 33 x 10^6 daltons per particle, with an apparent guanine plus cytosine content of 47 to 49 mol%, as determined by buoyancy and melting temperature, but with an unusual absorbance spectrum. Efficiency of plating is high if sufficient time is allowed for a relatively slow adsorption, which differs severalfold in rate between the two phages. Morphologically, these and other pneumococcal phages are similar to coliphage lambda but with a longer tail and tail fiber. Upon UV inactivation, ω3 and ω8 have D_{37} values of 33 and 55 J/m^2, respectively, and each shows multiplicity reactivation. A total of 13 ts mutants have been isolated from the two phages, representing only two complementation groups; complementation and recombination occur between ω3 and ω8 mutants. Both phages provoke high-titer antisera with extensive cross-reactivity against a number of newly isolated pneumococcal phages.

38809 Mismatch correction in pneumococcal transformation: donor lengtl. and hex-dependent marker efficiency. Guild, W.R.; Shoemaker, N.B. (Duke Univ., Durham, NC). Contract AT-(40-1)-3941. *J. Bacteriol.;* **125**: No. 1, 125-135(Jan 1976).

A hypothesis that preferential rejection of donor markers by the hex system of pneumococcus is due to lethal double-strand breaks has been examined in terms of its implications for the extent of the excision required. Experiments reported here were directed at asking whether hex-dependent marker efficiency depends on the length of the donor deoxyribonucleic acid (DNA). In the absence of intracellular competition for hex function, there was no detectable effect of DNA size on hex-dependent marker efficiency as donor DNA was sheared from greater than 1 x 10^7 daltons to 3.6 x 10^5 daltons. The latter DNA was purified by two successive velocity fractionations to ensure that the activity seen was representative of DNA of that size. Quantitative examination of the system shows that, for the lethal event hypothesis to be true, the excision step has to remove an average of 7,000 to 10,000 nucleotides. This figure is so much greater than that seen in other excision processes that alternate hypotheses should be considered. The presently known properties of the hex system can be accounted for by a model invoking the migratory features of type 1 restriction enzymes.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 38763, 38772, 38776, 38791

MORPHOLOGY

REFER ALSO TO CITATION(S) 38734, 38812, 38826

38810 Morphological markers of oncogenic transformation in respiratory tract epithelial cells. Heckman, C.A.; Olson, A.C. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Cancer Res.;* **39**: 2390-2399(Jul 1979).

The purpose of the studies was to determine whether changes in cell shape and microvillar density accompanied oncogenic transformation of rat respiratory tract epithelial cells. Two cell lines which became oncogenic during in vitro culture (1000 W and 165 S) were studied. In relatively late passages, but not in early passages, the lines produced keratinizing squamous cell carcinomas when tested in syngeneic hosts. Small colonies, predominantly of clonal origin, were obtained at early and late times after initiation of the lines into in vitro culture. Scanning electron microscopic studies showed that preoncogenic and oncogenic populations differed with respect to the shapes of cells within colonies. Differences in cell shape were further analyzed by estimation of the height and the ratio of length to width for 20 cells sampled from each colony. Each cell was assigned to one of nine classes of cell shape. The frequency with which spindle-shaped cells was observed in colonies increased 3-fold with oncogenic transformation of the 1000 W and 165 S lines. The frequency did not increase during in vitro culture of a third highly oncogenic cell line, BP 3-0. The frequency of observation of spindle-shaped cells in the 1000 W line was not decreased by in vivo growth and rederivation. In fact, the tumor-derived subline, 1000 WT, had a 5-fold greater frequency of expression than did an early passageof the 1000 W line. The number of colonies in which this cell shape was observed also increased 5-fold and came to include nearly one-half of the colonies analyzed. Therefore, expression of spindle shape became prevalent in clonal subpopulations of the line. In early passages of the 1000 W and 165 S lines, most spindle-shaped cells were found at the edges of colonies. This observation suggested that the spindle shape was assumed in response to forces generated during colony expansion.

PATHOLOGY

REFER ALSO TO CITATION(S) 38810, 38847, 38848

38811 Ultrastructure of red-sore lesions on largemouth bass (micropterus salmoides): association of the ciliate epistylis sp. and the bacterium aeromonas hydrophila. Hazen, T.C.; Raker, M.L.; Esch, G.W.; Fliermans, C.B. (Wake Forest Univ., Winston-Salem, NC). Contract EY-76-S-09-0900; EY-76-C-09-0819. *J. Protozool.;* **25**: No. 3, 351-355(1978).

Epizootic outbreaks of red-sore disease in several reservoirs in the southeastern United States have been reported to cause heavy mortality among several species of fish having sport and commercial value. The etiologic agent is said to be the peritrich ciliate Epistylis sp.; secondary infection by the gram-negative bacterium Aeromonas hydrophila produces hemorrhagic septicemia which results in death. However, in recent studies on the largemouth bass Micropterus salmoides, Epistylis sp. could be isolated from only 35% of 114 lesions from 114 fish, while A. hydrophila was found in 96% of the same lesions. Transmission and scanning electron microscopy of lesions associated with red-sore disease indicate that neither the stalk nor the attachment structure of Epistylis sp. have organelles capable of producing lytic enzymes. Since other investigators have shown that A. hydrophila produces strong lytic toxins, and in absence of evidence to the contrary, it is concluded that Epistylis sp. is a benign ectocommensal and that A. hydrophila is the primary etiologic agent of red-sore disease.

38812 Spontaneous cancer and its possible relationship to oxygen metabolism. Totter, J.R. (Oak Ridge Associated Universities, TN). Contract AC05-760R00033. *Proc. Natl. Acad. Sci. U.S.A.;* **77**: No. 4, 1763-1767(Apr 1980).

Mortality statistics for cancer in various countries and periods of time indicate that there has been little effect of industrialization on the inherent or spontaneous rate of occurrence of cancer. From US cancer statistics and the BEIR values [Report of the Advisory Committee on the Biological Effects of Ionizing Radiation (1979)] for radiation dose response, the ionizing radiation exposure required to produce a number of cancers equal to this spontaneous incidence was estimated to lie between 450 and 2100 rads (1 rad = 0.01 J/kg). From these cancer equivalent doses the number of single-strand DNA breaks required to produce the spontaneous cancers is estimated to be 0.26-1.3 per cell DNA per day. It is suggested that the univalent reduction of oxygen in normal metabolism to O_2 radical anion and subsequent production of more harmful radicals is the source of the DNA defects that, in cases where the defense mechanisms fail, lead to spontaneous cancer in the individual.

38813 Histopathology of red-sore disease (aeromonas hydrophila) in naturally and experimentally infected largemouth bass micropterus salmoides(lacepede). Huizinga, H.W. (Illinois State Univ., Normal); Esch, G.W.; Hazen, T.C. Contract AS09-76EV00900. *J. Fish Dis.;* **2**: 1-15(1979).

The histopathology of red-sore disease, caused by the gram-negative bacterium, Aeromonas hydrophila, is described for largemouth bass, Micropterus salmoides. Externally, lesions range from those affecting a few scales (pin-point), to those associated with extensive chronic ulcerations; there is focal hemorrhage, oedema and dermal necrosis which exposes underlying muscles producing infiltration of mononuclear and granulocytic inflammatory cells. Internally, the liver and kidneys are foci for toxic products produced by A. hydrophila with, in the most severe cases, complete destruction of the structural integrity of both organs. Pathological changes were not serious in either the spleen or heart, even in cases with massive damage in the liver and kidney. Internal and external lesions were similar in both natural and experimentally induced infections. The pathobiology of red-sore disease in bass was postulated to be linked to elevated water temperature stimulating increased metabolism, decreased body condition and stress, leading to the increased production of corticosteroids and the concommitant rise in susceptibility to infection.

38814 Thyroid tumours in the senile guppy, Lebistes reticulatus (Peters). Woodhead, A.D. (Brookhaven National Lab., Upton, NY). *Exp. Gerontol.;* **14**: 211-215(1979).

We have previously described a thyroid growth which had arisen spontaneously in a few senile fish from a laboratory population of guppies, Lebistes (Poecilia) reticulatus. We believed that this growth was neoplastic. Our histological interpretation has been questioned. In view of the problems in distinguishing between neoplastic an goitrous thyroid tissue in teleost fishes, we show photomicrographs of kidney and liver metastases from this tumor to support our earlier diagnosis.

PHYSIOLOGICAL SYSTEMS

REFER ALSO TO CITATION(S) 37795, 37840, 38748, 38751, 38756, 38757, 38762, 38781, 38782, 38797, 38799, 38801, 38838, 38848, 38849, 38858, 38863, 38866, 38873

38815 Light adaptation and temperature effects in rat PIII retinal response: analysis with a two-state model. Gale, J.G. (Univ. of Florida, Gainesville); Williams, T.P. Contract AT(40-1)-2690; 79-EV06021. *Proc. Natl. Acad. Sci. U.S.A.;* **77**: No. 7, 4021-4025(Jul 1980).

Aspartate-isolated PIII responses from excised perfused retinas of albino rats were studied, with emphasis on background adaptation and temperature effects. When responses are measured at their peaks, it is seen that the proportion of response elicited by the background is equal to the proportion by which a test-flash response is suppressed. This supports the notion that rat PIII, although a complex response, seems to approximate a simple two-state (compression) system and that it is therefore subject to analysis according to our recently proposed model. This model predicts that (i) responses from two-state systems should increase with decreasing temperature within limits; (ii) σ, the semisaturation constant of voltage-log intensity functions should shift to lower intensities with decreasing temperature; and (iii) the exact magnitude of the σ shift should follow the temperature dependence of the rate of rapid neural adaptation of the response. All of these predictions are verified for rat PIII. This suggests that rat PIII, although produced by at least two cell types, is being controlled by only two processes: a light-driven excitation and a rapid first-order neural dark adaptation.

38816 Oocyte-follicle cell gap junctions in Xenopus laevis and the effects of gonadotropin on their permeability. Browne, C.L.; Wiley, H.S.; Dumont, J.N. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Science;* **203**: 182-183(12 Jan 1979).

Junctions between Xenopus laevis oocytes and follicle cells have been identified as gap junctions by the passage of microinjected fluorescent dye from oocytes to follicle cells. The opening or assembly of these junctions, or both, appears to be regulated by gonadotropins.

38817 Thymic involvement in control of bone marrow growth. Use of T-cell-depleted hybrid mice. Goodman, J.W.; Shinpock, S.G.; Basford, N.L. (Oak Ridge National Lab., TN). *Exp. Hematol.;* **7**: No. 1, 17-26(Jan 1979).

Because of mounting evidence of thymus-derived cells in blood formation we have studied the growth of transplanted bone marrow in mice extensively depleted of T-lymphocytes (TCD). Poor growth of parental marrow was found not to be appreciably altered in TCD hybrid recipients. However, parental thymic lymphocytes even in massive doses were not able to augment hemopoiesis in TCD hosts, in contrast to findings from sham-thymectomized or age control mice. This indication that a third (host) cell takes part in the thymocyte-marrow stem cell interaction was reinforced by the finding that isogenic (hybrid) thymocytes administered to TCD mice 5 weeks before the final irradiation restored their ability to support thymocyte-induced augmentation of parental marrow growth. Data were obtained from θ-poor sham-thymectomized irradiated controls which are interpreted as evidence for a suppressor T cell. Thymocytes administered with marrow produced a shift toward granulopoiesis in TCD mice as well as in controls. From this finding we infer that although thymus-derived cells are intimately involved in regulation of myelopoiesis, the effect of administered thymic lymphocytes on the differentiative pathway does not depend on host T cells.

38818 Art of solid-phase enzyme immunoassay including selected protocols. Saunders, G.C. pp 99-118 of Immunoassays in the clinical laboratory. Nakamura, R.M. (ed.). New York, NY; Alan R. Liss, Inc. (1979).

In this chapter the art of enzyme immunoassay (EIA) is discussed and some of the solid-phase EIA procedures developed at the Los Alamos Scientific Laboratory are described in detail. While some of these procedures were developed to detect animal disease and food-borne toxins, their application to human disease problems should not be difficult. Many other workers have reported on EIA protocols developed for human health problems, and good reviews of the subject have been published recently. All procedures to be described have employed highly purified horseradish peroxidase as the enzyme amplifier. The reader should consult the review articles mentioned above, as well as the chapter in this volume by Dr. Eva Engvall, for information concerning techniques employing other enzyme amplifiers.

38819 Parabiotic demonstration of a humoral factor affecting megakaryocyte size in Sl/Sl/sup d/ mice (40263). Ebbe, S. (Lawrence Berkeley Lab., CA); Phalen, E.; Howard, D. *Proc. Soc. Exp. Biol. Med.;* **158**: 637-642(1978).

Parabiosis was done between Sl/Sl/sup d/ mice and their normal +/+ littermates and between pairs of +/+ mice. The purpose was to determine if Sl/Sl/sup d/ mice produced a substance that would stimulate megakaryocytopoiesis. It was found that +/+ mice attached to Sl/Sl/sup d/ mice showed macromegakaryocytosis suggesting that megakaryocytopoiesis was stimulated. Nonspecific findings in +/+ parabiotic pairs included a lesser degree of megakaryocytic macrocytosis. These findings did not appear to be due to growth of Sl/Sl/sup d/ stem cells in the +/+ parabionts. Radiation to Sl/Sl/sup d/ or +/+ bone marrow did not change the size of megakaryocytes. The results suggest that Sl/Sl/sup d/ mice produce a thrombopoietic substance even though they have a normal complement of circulating platelets.

38820 Temperature-independent diel variations of respiration rates in Quercus alba and Liriodendron tulipifera. Edwards, N.T.; McLaughlin, S.B. (Oak Ridge National Lab., TN). *Oikos;* **31**: 200-206(1978).

Diel cycles of bole and root respiration were observed in white oak and tulip poplar trees with highest rates occurring between 7 PM and midnight, and lowest rates between noon and 3 PM. Calculated Q_{10} values, using daily mean temperatures and daily mean respiration rates, ranged from 1.9 to 4.8 and averaged 3.2 during several days in April and May. Respiration rates predicted from temperatures, in which Q_{10} was assumed equal to 2, followed a diel cycle 180 degrees out of phase with measured rates. It is suggested that any use of the classical Q_{10} relationship to predict respiration rates in a natural forest environment be considered suspect unless other controlling variables are considered. Reducing sugar concentrations in tulip poplar boles followed a similar diel cycle as respiration rates, suggesting a correlation between reducing sugar concentrations and respiration rates. In girdling experiments, respiration rates immediately above the incision of a girdled tulip poplar were up to five times higher than the control, while rates below the girdle dropped to about one-third of the control by the twelfth week after the tree was girdled. Diel respiration cycles were observed both above and below the girdle. We suggest that trees possess a diel scheme of food utilization whereby food catabolism is synchronized with growth processes at night when moisture availability is high.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 38769, 38770, 38775, 38800, 38876

38821 Odontomas in Peromyscus leucopus. Finkel, M.P. Lombard, L.S.; Staffeldt, E.F.; Duffy, P.H. (Argonne National Lab., IL). *J. Natl. Cancer Inst.;* **63**: No. 2, 407-411(Aug 1979).

A colony of Peromyscus leucopus was established 15 years ago from animals trapped in the deciduous forest at Argonne National Laboratory, Argonne, Illinois. A roentgenographic survey of the skeletons of 189 of these untreated animals dying during a 13-month period disclosed 48 odontogenic growths in 21 of the mice. These

growths were diagnosed on histopathologic examination as complex odontomas, the incidence of which was higher in males than in females. In this relatively small sample, these benign tumors appeared to be associated with youth rather than old age.

38822 Migration of intraperitoneally injected thyroid cells in the Amazon molly, Poecilia formosa. Woodhead, A.D.; Setlow, R.B.; Scully, P.M. (Brookhaven National Lab., Upton, NY). *Cancer Res.;* **39**: 2698-2703(Jul 1979).

We have previously reported the development of an extensive invasive growth of the thyroid gland of the gynogenetic teleost, Poecilia formosa (the Amazon molly), following i.p. injection of uv- or γ-irradiated thyroid cells. This result was suprising by comparison with mammalian work, in which the thyroid is rarely the site for tumor metastases, but the anatomy of the circulation of fish is different from mammals, and in fish the gills and thyroid gland would be among the first tissues in which injected cells might be arrested. Techniques using a fluorescent dye, ^{125}I membrane label, or [^{3}H]thymidine label were used to follow the distribution of i.p. injected cells in the Amazon molly. Fish sampled as soon s 30 min after injection had some labeled cells dispersed in the connective tissue around the ventral aorta and in the bases of the gills, and by 1 to 4 h large numbers of cells had moved into the thyroid region. A few cells still persisted there 200 h later. Experiments on the distribution of heat-killed cells indicated that the initial distribution of the cells was largely governed by mechanical factors. Injected cells would appear to be disseminated in fish by mechanisms similar to those in mammals.

38823 Metabolic fate of ^{13}N-labeled ammonia in rat brain. Cooper, A.J.L. (Cornell Univ., New York, NY); McDonald, J.M.; Gelbard, A.S.; Gledhill, R.F.; Duffy, T.E. Contract EE-77-5-02-4268. *J. Biol. Chem.;* **254**: No. 12, 4982-4992(25 Jun 1979).

After infusion of physiological concentrations of [^{13}N]ammonia for 10 min via one internal carotid artery, the relative specific activities of glutamate, glutamine (α-amino), and glutamine (amide) in rat brain were approximately 1:5:400, respectively. Analysis of metabolites, after infusion of [^{13}N]ammonia into one lateral cerebral ventricle, indicated that ammonia entering the brain from the cerebrospinal fluid is also metabolized in a small glutamate pool. Pretreatment with methionine sulfoximine led to a decrease in the label present in brain glutamine following carotid artery infusion of [^{13}N]ammonia. ^{13}N activity in brain glutamate was greater than in the α-amino group of glutamine. The amount of label recovered in the right cerebral hemisphere, 5 s after a rapid bolus injection of [^{13}N]ammonia via the right common carotid artery, was independent of concentration within the bolus over a 1000-fold range indicating that ammonia enters the brain largely by diffusion. In normal rats approximately 60% of the label recovered in brain was incorporated into glutamine, indicating that the t_1/sub//$_2$ for conversion of ammonia to glutamine in the small pool is in the range of 1 to 3 s or less. The data emphasize the importance of the small pool glutamine synthetase as a metabolic trap for the detoxification of blood-borne and endogenously produced brain ammonia. The possibility that the astrocytes represent the anatomical site of the small pool is considered.

PUBLIC HEALTH

REFER ALSO TO CITATION(S) 38677, 38877, 38879

38824 Accuracies of computer versus manual linkages of routine health records. Smith, M.E.; Newcombe, H.B. (Atomic Energy of Canada Ltd., Chalk River, Ontario). *Methods Inf. Med.;* **18**: No. 2, 89-97(Apr 1979).

Empirical tests of the application of computer record linkage methods versus the use of routine clerical searching, for bringing together various vital and ill-health records, have shown that the success rate for the computer operation was higher (98.3 versus 96.7 per cent) and the proportion of false linkages very much lower (0.1 versus 2.3 per cent). The rate at which the ill-health records were processed by the computer was approximately 14,000 per minute of central processor time, representing a cost of a half a cent apiece. Factors affecting the speed, accuracy and cost of computerized record linkage are discussed.

AGRICULTURE AND FOOD TECHNOLOGY

REFER ALSO TO CITATION(S) 37846, 37887, 38731, 38736, 38864, 38865

38825 Seaweed culture in Washington and British Columbia: potential and practice. Mumford, T.F. Jr. (Dept. of Natural Resources, Olympia, WA). pp 13-30 of International symposium on Coastal Pacific marine life. Bellingham, WA; Western Washington University (1980).

From International symposium on Coastal Pacific marine life; Bellingham, WA, USA (15 Oct 1979).

Although no active commercial harvesting or culture of seaweeds is taking place in Washington or British Columbia as of mid-1979, there is active planning of management of wild stocks and research funded by industry and federal, state and provincial governments to devise technology for the culture of seaweeds. An orderly development is taking place with considerations being given to markets, biology, technology, and site selection. Economic analysis of the projects is being undertaken. We stand on the threshold of utilization of the unique marine waters of Washington and British Columbia for the production of food, valuable chemicals and possibly energy, using the seaweeds to capture the energy of the sun.

38826 Microscopic observations on cuticle from trichomeless, tr, and normal, Tr, pearl millet. Hanna, W.W.; Akin, D.E. (Univ. of Georgia, Tifton). Contract EY-76-S-09-0637. *Crop Sci.;* **18**: 904-905(Sep 1978).

Leaves of trichomed (Tr) and trichomeless (tr) pearl millet were studied with both electron and light microscopy to determine morphological differences that may account for the differences in transpiration rate, pest resistance, and penetration of rumen microbes through the leaf surface between the two lines. Slight differences were observed in cuticle thickness. Encrustation of epidermal cell walls in tr cuticle indicate chemical differences between tr and Tr cuticle. The cuticle of Tr plants had 3X and 1.3X as many cracks of the adaxial and abaxial leaf surfaces, respectively, as that of tr plants. This helps to explain why tr leaves transpire less water than Tr leaves and why there is more penetration of rumen microbes through the surface of Tr leaves as compared to tr leaves.

38827 Assessment of alternatives to present day ammonia technology with emphasis on coal gasification. Nichols, D.E.; Williamson, P.C.; Waggoner, D.R. Muscle Shoals, Alabama; Tennessee Valley Authority (1978). 34p. (CONF-7806192—1).

From Steenbock-Kettering international symposium on nitrogen fixation; Madison, WI, USA (12 Jun 1978).

In 1977, the United States used 60 percent more natural gas and 100 percent more oil than was discovered. Even with declining usage, most experts predict that our natural gas will essentially be depleted in 2 or 3 decades. Natural gas is the feedstock for practically all nitrogen fertilizer produced in the United States. Development of alternate feedstock technology is necessary to prevent serious future shortages of nitrogen fertilizers. Coal appears to be the only viable alternative for the foreseeable future. The Tennessee Valley Authority has established a project to develop and demonstrate the production of ammonia from coal. Plans are for the facility to be on-stream early in 1980. Process technology is discussed and the economics of producing ammonia in the United States from natural gas, oil, naphtha, coal, and electrolytic hydrogen are presented. Sensitivity analyses are used to show the effects of cost of feedstock, cost of capital, and on-stream efficiency.

38828 Growth of Pacific Northwest marine algae on arfiticial substrates: potential and practice. Mumford, T.F. Jr. pp 139-161 of Marine plant biomass of the Pacific Northwest coast. Krauss, R. (ed.). Corvallis, OR; Oregon State Univ. Press (1978).

The use of artificial substrates for the culture of marine algae has a long history. The edible seaweeds Porphyra, Laminaria, and Undaria are now grown on nets in a large and technologically advanced industry. More recently, algae used for the supply of phycocolloids are being grown on nets, Eucheuma in the Philippines and Iridaea and Macrocystis on the west coast of North America. Techniques being developed will open to utilization wide areas of the oceans for the production of marine algae for energy, sources of hydrocarbons, and chemical, food, and pharmaceutical products.

BIOMEDICAL SCIENCES, APPLIED STUDIES

RADIATION EFFECTS ON BIOCHEMICALS

IN VITRO

38829 Ultra violet-endonuclease from calf thymus with specificity toward pyrimidine dimers in DNA. Waldstein, E.A. (Tel-Aviv Univ., Israel); Peller, S.; Setlow, R.B. *Proc. Natl. Acad. Sci. U.S.A.;* **76**: No. 8, 3746-3750(Aug 1979).

We describe the partial purification of an endonuclease from calf thymus that nicks phage PM2 DNA irradiated with uv doses producing only a few pyrimidine dimers per molecule. It has much less activity on DNA that has been subjected to enzymatic photoreactivation after uv irradiation. The calf thymus endonuclease is

different from other mammalian uv-endonucleases so far described in that it seems to be dimer specific. The enzyme is stimulated by Mg^{2+} and is inactive in the presence of EDTA. It binds to uv-irradiated DNA-Sepharose from which it is released by low concentrations of KCl. Gel filtration data indicate that the endonuclease may belong to a high molecular weight protein or protein complex. The enzyme is very labile and freezing increases it lability.

RADIATION EFFECTS ON CELLS

EXTERNAL SOURCE

38830 Inhibition of DNA repair in ultraviolet-irradiated human cells by hydroxyurea. Francis, A.A. (Oak Ridge National Lab., TN); Blevins, R.D.; Carrier, W.L.; Smith, D.P.; Regan, J.D. Contract W-7405-ENG-26. *Biochim. Biophys. Acta;* **563**: 385-392(1979).

The effect on DNA repair in ultraviolet-irradiated human skin fibroblasts by hydroxyurea has been examined in this study using three independent methods for measuring DNA repair: the 5-bromodeoxyuridine photolysis assay which measures DNA repair replication, chromatographic measurement of thymine-containing dimers, and measurement of specific ultraviolet-endonuclease-sensitive sites in irradiated DNA. Little effect of hydroxyurea was observed at the concentration of 2 mM, which is often used to inhibit semiconservative DNA synthesis; however, 10 mM hydroxyurea resulted in marked inhibition (65 to 70%) of excision repair. This inhibition was accompanied by a possible doubling in the size of the repaired region. The accumulation of large numbers of single-strand breaks following ultraviolet irradiation and hydroxyurea incubation seen by other investigators was not observed with the normal skin fibroblasts used in this study. A comparison of hydroxyurea effects on the different DNA repair assays indicates inhibition of one step in DNA repair also results in varying degrees of inhibition of other steps as well.

38831 Comparison of the lethal and mutagenic effects of gold and white fluorescent lights on cultured mammalian cells. Burki, H.J.; Lam, C.K. (Univ. of California, Berkeley). *Mutat. Res.;* **54**: 373-377(1978).

In summary, the results reported here suggest that it may be important to remove white fluorescent lights from tissue culture laboratories and replace them with non-mutagenic gold fluorescent lights in the same fixtures or use suitable filters to cover white fluorescent lights to remove wavelengths below 5000 A. It is also important to note again that the mutagenic risk to humans from usual doses of white fluorescent light is very small compared to normal mutagenic exposures received every day from the sun.

RADIATION EFFECTS ON ANIMALS

MAN

REFER ALSO TO CITATION(S) 38812

38832 (CONF-8003106—1) **Genetic effects of low-level irradiation.** Selby, P.B. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 21p. NTIS, PC A02/MF A01.

From Symposium on the biological risks of medical irradiations; San Antonio, TX, USA (26 Mar 1980).

Recent estimates of the genetic effects of radiation by two widely recognized committees (BEIR III and UNSCEAR 1977) are based to a large extent on data collected in mice using either the specific-locus method or the approach of empirically determining the nature and extent of radiation-induced genetic damage to the skeleton. Both committees made use of doubling-dose and direct methods of estimating genetic hazard. Their estimates can be applied to assessments of risk resulting from medical irradiation in terms both of risk to the population at large and to the individual.

38833 (DOE/EV/10360—1) **Correlation of chromosome patterns in human leukemic cells with exposure to chemicals and/or radiation. Progress report, January 1, 1980-Dec 31, 1980.** Rowley, J.D. (Chicago Univ., IL (USA)). Sep 1980. Contract AC02-80EV10360. 19p. NTIS, PC A02/MF A01.

The relationship of the chromosome pattern in leukemic cells to prior disease and to the type of therapy are summarized. Although the karyotype seen in secondary ANLL is distinctly different from that seen in the primary malignancy, the nature of the primary disease may influence the pattern of karyotypic changes seen in the leukemic cell. This notion is very speculative and is based on limited observations. Two of three patients with leukemia following multiple myeloma were unique in that they were the only ones whose leukemic cells had more than 48 chromosomes, with +1, +6, +8, +21; this constellation of abnormalities was not seen in any of the other patients. Since most of the patients had received both radiotherapy and chemotherapy, it is difficult to determine whether specific chromosome changes are related more closely to one rather than the other of these types of therapy. It appears, however, that combined therapy is much more likely to result in abnormalities of both No. 5 and No. 7 (9/15 patients) than is either modality used alone (1/12). (ERB)

38834 Current status of clinical particle radiotherapy at Lawrence Berkeley Laboratory. Castro, J.R.; Quivey, J.M.; Lyman, J.T.; Chen, G.T.Y.; Phillips, T.L.; Tobias, C.A.; Alpen, E.L. (Univ. of California, Berkeley). Contract W-7405-ENG-48. *Cancer;* **46**: No. 4, 633-641(15 Aug 1980).

Clinical experience with charged particle irradiation of human cancers has been underway at the University of California Lawrence Berkeley Laboratory. Over 150 patients have been irradiated with heavy charged particle beams including helium, carbon, neon, and argon ions. Pilot studies have included such tumor sites as glioma of the brain, carcinoma of the esophagus, carcinoma of the pancreas, carcinoma of the stomach, ocular melanoma, and carcinoma of the uterine cervix. Prospective studies are planned to investigate the improved dose localization potential (helium) and the enhanced biologic and physical dose potential (carbon, neon) in a controlled trial against the best available megavoltage irradiation techniques.

38835 Search for mutations affecting protein structure in children of atomic bomb survivors: preliminary report. Neel, J.V. (Univ. of Michigan, Ann Arbor); Satoh, C.; Hamilton, H.B.; Otake, M.; Goriki, K.; Kageoka, T.; Fujita, M.; Neriishi, S.; Asakawa J. *Proc. Natl. Acad. Sci. U.S.A.;* **77**: No. 7, 4221-4225(Jul 1980).

A total of 289,868 locus tests, based on 28 different protein phenotypes and using one-dimensional electrophoresis to detect variant proteins, has yielded one probable mutation in the offspring of proximally exposed parents, who received an estimated average gonadal exposure of 31 to 39 rem in the atomic bombings of Hiroshima and Nagasaki. There were no mutations in 208,196 locus tests involving children of distally exposed parents, who had essentially no radiation exposure.

38836 Leukemia in women following radiotherapy for cervical cancer: ten-year follow-up of an international study. Boice, J.D. (National Institutes of Health, Bethesda, MD); Hutchison, G.B. *J. Natl. Cancer Inst.;* **65**: No. 1, 115-129(Jul 1980).

An international collaborative study, with 69 references, of 31,219 women treated for cervical cancer from 30 radiotherapy centers in nine countries was conducted. Patients were followed clinically and with blood studies between 1960 and 1970, and 148,000 woman-years (WY) were accumulated. Among 28,490 women treated with either intercavitary radium, external radiation, or both, 134,000 WY were accumulated and 13 cases of leukemia were observed. On the basis of general population rates, 15.5 cases were expected. A twofold risk could thus be excluded, but a 1.4-fold risk remained possible. In absolute terms, risks larger than 0.1 leukemia cases per 10^6 WY-rad could be excluded. Among 2,729 cervical cancer patients not irradiated but similarly evaluated, 14,000 WY were accumulated and 2 cases of leukemia were observed as compared with 1.0 expected. In the interval 4-8 years after exposure, the period in which any leukemogenic effect might be most apparent, 7 cases of leukemia were observed among exposed patients as compared with 5.4 expected. The absence of an increased leukemia risk suggested that the radiation regimens used to treat cervical cancer are not so effective in inducing leukemia as are other radiation exposures that have been studied.

38837 Nasopharyngeal cancer: a review of 1605 patients treated radically with cobalt 60. Huang, S.C. (National Taiwan Univ., Taipei). *Int. J. Radiat. Oncol., Biol. Phys.;* **6**: No. 4, 401-407(Apr 1980).

A retrospective study was performed on 1605 patients with histologically proven and radically treated nasopharyngeal carcinoma. All were followed for a minimum of five years; 833 patients had a minimum follow-up period of ten years. Treatment results were reviewed according to: (1) size of primary tumor; (2) base of skull invasion; (3) cranial nerve involvement; (4) cervical node metastases; and (5) distant spread. An appropriate staging system was developed that reflected these prognostic factors. The evidence presented indicates that in this series of patients, base of skull involvement was less ominous than cranial nerve involvement. Unilteral lymph node involvement carried a better prognosis than bilateral neck nodes, this was the poorest sign of all since it predicted distant metastases. The average 5-year survival rate for 1605 patients in all stages, was 529/1605(32.1%); the 10-year survival rate for 833 patients in all stages was 20.2%.

VERTEBRATES

38838 Potentiation of chemically induced lung fibrosis by thorax irradiation. Haschek, W.M.; Meyer, K.R.; Ullrich, R.L.; Witschi,

H.P. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Int. J. Radiat. Oncol., Biol. Phys.;* 6: No. 4, 449-455(Apr 1980).

Intraperitoneal injection of butylated hydroxytoluene (BHT) causes epithelial cell death, followed 2 to 4 days later by extensive proliferation of type II alveolar cells in mouse lung. Five to 8 days after BHT, most dividing cells are capillary endothelial cells or interstitial cells. In animials that were exposed to 200 rad thorax irradiation immediately or 1 day after BHT, lung hydroxyproline was increased 2 weeks later. The response was dose dependent, and the interaction between BHT and thorax irradiation was synergistic. Light microscopy showed abnormal accumulation of collagen in the alveolar septa. Lung hydroxyproline was not increased in animals that were irradiated 6 days after BHT, compared to animals treated with BHT alone. We concluded that fibrosis develops if lung is damaged by a blood-borne agent and radiation to the thorax occurs at a time when it may compromise alveolar reepithelialization. Exposure to x-rays during proliferation of capillary endothelial cells or interstitial cells does not enhance development of fibrosis.

38839 Acute monocytic leukemia in an irradiated beagle. Tolle, D.V.; Seed, T.M.; Fritz, T.E.; Lombard, L.S.; Poole, C.M.; Norris, W.P. (Argonne National Lab., IL). *Vet. Pathol.;* **16**: 243-254(1979).

A purebred female Beagle dog that had received 2,000 R of protracted whole-body γ-irradiation from ^{60}Co when 14 months old had hematologic changes consistent with a myeloproliferative disorder 3 years after the termination of radiation exposure. Peripheral blood and bone marrow findings during the 7-month period before death showed progressive anemia with increased numbers of platelets; immature granulocytes, monocytes and promonocytes. A period of partial remission occurred during which time the peripheral blood was aleukemic, although there was marked thrombocytosis and abnormal erythropoiesis which was evidenced by bizarre circulating nucleated red cells, anisocytosis, poikilocytosis and Howell-Jolly bodies. The dog had a terminal crisis with marked leukocytosis, most cells in the peripheral blood being bizarre monocytes and promonocytes. Tissues obtained at necroscopy showed diffuse as well as focal infiltration of the spleen, liver, lymph nodes, heart, kidney and gastrointestinal wall with immature neoplastic cells resembling monocytes and monocytic precursors. The monocytic differentiation of the invasive cell population was confirmed by morphological, cytochemical, histological, ultrastructural and in vitro cell culture studies.

RADIONUCLIDE EFFECTS - INTERNAL SOURCE

MAN

REFER ALSO TO CITATION(S) 38832

38840 Breast cancer in female radium dial workers first employed before 1930. Adams, E.E.; Brues, A.M. (Argonne National Lab., IL). Contract W-31-109-ENG-38. *J. Occup. Med.;* **22**: No. 9, 583-587(Sep 1980).

Female radium dial workers first employed before 1930 were analyzed for breast cancer mortality and incidence using method and rate tables described by Monson and the Mantel-Haenszel summary chi-square test for significance. Of 1180 located women, 736 were measured to estimate radium intake. This measured group was analyzed for breast cancer mortality and incidence according to four possible risk factors: radium intake dose, duration of employment, age at first exposure, and parity. The measured women showed a significant excess of breast cancer incidence and mortality only among those women with a radium intake of 50 μCi or greater.

NUCLIDE KINETICS AND TOXICOLOGY

MAN

REFER ALSO TO CITATION(S) 38705

38841 (DOE/TIC—11273) **External dosimetry.** Kocher, D.C. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 50p. NTIS, PC A03/MF A01.

The concept of a dose-rate conversion factor for external exposure to photons and electrons and its application to the estimation of population dose following routine or accidental releases of radionuclides to the atmosphere were discussed. Dose-rate conversion factors are useful for exposure situations in which the radionuclide concentration is uniform within a certain distance of the exposed individuals. This distance is approximately equal to the electron range or to three photon mean-free-paths for the medium, which is usually air. If this approximation is valid, the external dose rate is obtained by multiplying the known radionuclide concentration in the environment by the dose-rate factors for the organs of interest for the particular radionuclides. These dose-rate factors are available in published compilations. A brief discussion is given of calculations of external dose for photons for exposure situations in which the radionuclide concentration is not uniform and infinite in extent. Such calculations are based on the concept of the point-isotropic specific absorbed fraction. Although computer codes are generally available for this purpose, these situations may require special treatment on a case-by-case basis. Corrections to calculated external dose rates to account for building shielding during indoor residence, ground roughness and terrain irregularities, and penetration of radionuclides into the ground are also discussed. These effects are usually important in realistic population dose assessments. (ERB)

38842 (SAND—80-2148C) **Radiation protection: an analysis of thyroid blocking.** Aldrich, D.C.; Blond, R.M. (Sandia National Labs., Albuquerque, NM (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Systems and Reliability Research). 1980. Contract AC04-76DP00789. 14p. (CONF-801056—5; IAEA-CN—39/102). NTIS, PC A02/MF A01.

From International conference on current nuclear power plant safety issues; Stockholm, Sweden (26 Oct 1980).

An analysis was performed to provide guidance to policymakers concerning the effectiveness of potassium iodide (KI) as a thyroid blocking agent in potential reactor accident situations, the distance to which (or area within which) it should be distributed, and its relative effectiveness compared to other available protective measures. The analysis was performed using the Reactor Safety Study (WASH-1400) consequence model. Four categories of accidents were addressed: gap activity release accident (GAP), GAP without containment isolation, core melt with a melt-through release, and core melt with an atmospheric release. Cost-benefit ratios (US $/thyroid nodule prevented) are given assuming that no other protective measures are taken. Uncertainties due to health effects parameters, accident probabilities, and costs are assessed. The effects of other potential protective measures, such as evacuation and sheltering, and the impact on children (critical population) are evaluated. Finally, risk-benefit considerations are briefly discussed.

THERMAL EFFECTS

MICROORGANISMS

REFER ALSO TO CITATION(S) 38844

INVERTEBRATES

REFER ALSO TO CITATION(S) 38844

38843 (PB—80-129703) **Dynamics and control of the Asiatic clam in the New River, Virginia. Research report.** Cherry, D.S.; Rodgers, J.H. Jr.; Graney, R.L.; Cairns, J. Jr. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Virginia Water Resources Research Center). Jan 1980. 80p. NTIS, PC A05/MF A01.

The Asiatic clam, Corbicula fluminea, has invaded the New River at the rate of 9 miles a year from the Kanawha River, which enters downstream from the Glen Lyn coal-powered generating plant in Virginia. During the period of investigation, October 1976-September 1978, clams were more numerous in the vicinity of the thermal discharge of the plant than they were in unheated waters, and their population fell sharply during the winter months, when the water temperature dropped to approximately 2C. The temperature (35C) of the heated discharge water in late summer did not adversely affect the clam. High mortality occurred at temperatures greater or equal to 36C in laboratory thermal tolerance studies. The clam proved to be highly resistant to the conventional biocidal practice of intermittent chlorination and to exposure to heavy metals in both static and artificial stream bioassays. Copper was more toxic than either zinc or a combination of zinc and copper. Potassium was not an effective biocidal agent at low concentrations (less than 100 mg/l). Measurements of 42 elements in water, sediment, clam shell, and visceral tissue revealed that Corbicula was an efficient accumulator of many elements.

VERTEBRATES

38844 (PB—80-130172) **Browns Ferry biothermal research series. II. Effects of temperature on bluegill and walleye, and periphyton, macroinvertebrate, and zooplankton communities in experimental ecosystems. Research report.** Wrenn, W.B.; Armitage, B.J.; Rodgers, E.B.; Forsythe, T.D.; Grannemann, K.L. (Tennessee Valley Authority, Decatur, AL (USA). Browns Ferry Biothermal Research). Aug 1979. 187p. NTIS, PC A09/MF A01.

Effects of long-term, March-September 1977, temperature elevations on aquatic communities in 12 outdoor experimental channels were evaluated. Macroinvertebrates, periphyton, and zooplankton colonized the channels naturally from the water supplied from

Wheeler Reservoir, Tennessee River. The fish community consisted of stocked adult bluegill and juvenile walleye. Four temperature regimens, with three replicate channels per regimen, were maintained. The major objective of the study is to provide information for establishing temperature criteria for protection of important sport and commercial fish species.

CHEMICALS METABOLISM AND TOXICITY

REFER ALSO TO CITATION(S) 38697, 38723, 38798

38845 (PB—80-124753) **Air quality criteria for ozone and other photochemical oxidants.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Criteria and Assessment Office). Apr 1978. 372p. NTIS, PC A16/MF A01.

This document consolidates and assesses current knowledge regarding the origin of ozone and other photochemical oxidants and discusses their effect on health, vegetation, certain ecosystems, and materials. This document summarizes current data on the effects of oxidant/ozone in the ambient air on man, vegetation, and ecosystems. The effects that have been observed will form the scientific basis for supporting the present National Ambient Air Quality Standard of 160 micrograms/cu m (0.08 ppm) or a revised standard. Although nitrogen dioxide is considered one of the photochemical oxidants, oxides of nitrogen are the subject of a separate report and are therefore discussed in this document only as they participate in the formation and reactions of other photochemical oxidants. Hydrocarbons and other organics are important air pollutants because they too are precursors of other compounds formed in the atmospheric photochemical system. In this document, toxic organics are considered only with respect to eye irritation. The studies and data cited constitute the best available basis for specific standards aimed at protecting human health and the environment from photochemical oxidants in ambient air.

38846 **Toxic materials control program at ORNL revisited.** Ketchen, E.; Porter, W. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Am. Ind. Hyg. Assoc. J.;* **41**: No. 4, 277-282(Apr 1980).

For large industrial and research operations, maintaining reasonable control of all toxic materials used in their operations can be a formidable task. A system utilizing cards has been developed which serves a dual purpose, informing the user regarding hazards of a particular material and also facilitating appropriate workplace surveillance during its use. Selected hazard data and spill notification message, if applicable, are printed on the card. The card contains a label which the user detaches and affixes to the container. This label classifies the material according to toxicity, flammability, reactivity, special properties on a 0 through 4 hazard rating, and spill message if needed to comply with environmental requirements.

CELLS

REFER ALSO TO CITATION(S) 38882

38847 (CONF-800498—2) **Mutagenesis and differentiation induction in mammalian cells by environmental chemicals.** Friedman, J.; Huberman, E. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 21p. NTIS, PC A02/MF A01.

From Symposium on mutagenesis and carcinogenesis; Warsaw, Poland (21 Apr 1980).

These studies indicate that in agreement with the somatic mutation hypothesis, chemical carcinogens: (1) are mutagenic for mammalian cells as tested in the cell-mediated assay; (2) the degree of mutagenicity is correlated with their degree of carcinogenicity; (3) that at least in cases when analyzed carefully the metabolites responsible for mutagenesis are also responsible for initiating the carcinogenic event; and (4) that a cell organ type specificity can be established using the cell-mediated assay. Studies with HL-60 cells and HO melanoma cells and those of others suggest that tumor-promoting phorbol diesters can alter cell differentiation in various cell types and that the degree of the observed alteration in the differentiation properties may be related to the potency of the phorbol esters. Thus these and similar systems may serve as models for both studies and identification of certain types of tumor promoting agents. (ERB)

38848 (CONF-800498—3) **Dynamic model for selective metabolic activation in chemical carcinogenesis.** Selkirk, J.K.; MacLeod, M.C. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 14p. NTIS, PC A02/MF A01.

From Symposium on mutagenesis and carcinogenesis; Warsaw, Poland (21 Apr 1980).

Theoretical calculations predict the relative ease of formation of carbonium ions from 7,8-dihydro-7,8-dihydroxybenzo(a)pyrene-9,10-oxide or from either of the 2 symmetrical bay regions of B(e)P, and suggest their attraction to cellular nucleophiles. When both isomers were metabolized by hamster embryo fibroblasts (HEF) and the products analyzed, the results showed that the probable reason for benzo(e)pyrene's lack of carcinogenicity was its metabolic preference to attack the molecule away from the bay-region area. Particularly striking was the absence of any evidence for the formation of a significant amount of B(e)P-9,10-dihydrodiol. This suggests a metabolic basis for the relative lack of carcinogenic and mutagenic activity of B(e)P. The reason for this is not clear but may be due to physical or chemical factors such as membrane solubility or stereochemical requirements of the active site of the enzyme. The bay-region theory of PAH carcinogenesis predicts that carbonium ion formation from 9,10-dihydro-9,10-dihydroxybenzo(e)pyrene-11, 12-oxide, if formed, would be energetically favorable. Thus, the inability of HEF and microcomes to form B(e)P-9,10-dihydrodiol, the precursor of its potentially highly reactive diol-epoxide, would explain the relative inertness of B(e)P in several biological systems. As the subtle biochemical interactions of the various carcinogen intermediates become clarified, it becomes apparent that susceptibility and resistance to malignant transformation are based on a complex set of both chemical and physical parameters. It is becoming clear that metabolism kinetics, membrane interaction, and the role of nuclear metabolism help dictate the passage of the carcinogen and its reactive intermediates into and through the metabolic machinery of the cell. (ERB)

38849 **Inhibition of human polymorphonuclear leukocyte chemotaxis by oxygenated sterol compounds.** Gordon, L.I.; Bass, J.; Yachnin, S. (Univ. of Chicago, IL). Contract EY-76-C-02-0069. *Proc. Natl. Acad. Sci. U.S.A.;* **77**: No. 7, 4313-4316(Jul 1980).

When preincubated with certain oxygenated sterol compounds in lipoprotein-depleted serum [20% (vol/vol)], human polymorphonuclear leukocytes show inhibition of chemotaxis toward the synthetic dipeptide N-formylmethionylphenylalinine without alteration of random movement or loss of cell viability. These effects can occur at sterol concentrations as low as 6.25 μM and after as little as 5 min of preincubation, but they are increased at higher concentrations and longer preincubation times. The inhibition can be almost completely reversed by preincubation in lipoprotein-replete serum [human AB serum, 20% (vol/vol)] and may be partially corrected by addition of free cholesterol (0.125 mM) to the medium. These effects are unlikely to be due to inhibition of cellular sterol synthesis, competition for chemotaxin membrane binding sites, or deactivation of the leukocytes but they may be a consequence of insertion of the sterol molecule into the leukocyte plasma membranes.

38850 **Cultured mouse embryos metabolize benzo[a]pyrene during early gestation: genetic differences detectable by sister chromatid exchange.** Galloway, S.M. (Univ. of California, San Francisco); Perry, P.E.; Meneses, J.; Nebert, D.W.; Pedersen, R.A. *Proc. Natl. Acad. Sci. U.S.A.;* **77**: No. 6, 3524-3528(Jun 1980).

Mouse embryos explanted at 7 1/2 or 8 1/2 days of gestation were cultured in medium containing benzo[a]pyrene and supplemented with 5-bromodeoxyuridine to allow detection of sister chromatid exchanges. The murine Ah locus regulates the inducible metabolism of polycyclic hydrocarbons such as benzo[a]pyrene. A high frequency of sister chrcmatid exchanged was induced by benzo[a]pyrene in embryos from three Ah- responsive inbred strains; there was little or no increase in two Ah-nonresponsive inbred strains. Benzo[a]pyrene also induced sister chromatid exchanges in the Ah-responsive recombinant inbred line B6NXAKN-12 but not in the Ah-nonresponsive recombinant inbred line B6NXAKN-3. Sister chromatid exchange in cultured Ah-responsive mouse embryos was thus shown to be a sensitive assay. These data provide direct evidence that genetically responsive mouse embryos possess the subcellular processes necessary for induction of enzymes that metabolize benzo[a]pyrene to its chemically active form(s). Both the Ah regulatory gene product and the structural gene product therefore appear to be functional at an early embryonic age. Furthermore, this metabolic capacity may play an important role in the damage to embryonic cells by polycyclic hydrocarbons.

38851 **DNA alkylation and unwinding induced by benzo[a]pyrene diol epoxide: modulation by ionic strength and superhelicity.** Gamper, H.B.; Straub, K.; Calvin, M.; Bartholomew, J.C. (Univ. of California, Berkeley). Contract W-7405-ENG-48. *Proc. Natl. Acad. Sci. U.S.A.;* **77**: No. 4, 2000-2004(Apr 1980).

Superhelical and partially relaxed DNAs of simian virus 40 were allowed to react in vitro with(+-)-7β,8α-dihydroxy-9α,10α-epoxy-7,8,9,10-tetrahydrobenzo[a]pyrene (BaP diol epoxide). The modified DNA contained N^2 guanine and N^6 adenine hydrocarbon adducts in the ratio 86:14. Superhelical simian virus 40 DNA was approximately 6% more susceptible to modification than was partially relaxed viral DNA. Counterions inhibited DNA alkylation by up to 80%, Mg^{2+} being 50-fold more effective than Na^+. The sensitivity of covalent binding to helix stability is consistent with a reaction complex in which BaP diol epoxide is intercalated. The superhelical density of the modified DNA substrates was determined electrophoretically relative to partially relaxed standards, and an unwinding angle for the hydrocarbon adducts was calculated. The angle was

dependent upon the superhelicity of the DNA molecule and ranged from 330° to 30°. These data indicate that the modified base pairs are disrupted and, in the presence of torsional strain, act as centers for the further denaturation of up to eight adjacent base pairs. In the absence of such strain the alkylation sites have an ordered structure, with the attached hydrocarbon probably oriented in the minor or major groove of the helix.

38852 Identification of 7,12-dimethylbenz[a]anthracene metabolites that lead to mutagenesis in mammalian cells. Huberman, E. (Oak Ridge National Lab., TN); Chou, M.W.; Yang, S.K. Contract W-7405-ENG-26. *Proc. Natl. Acad. Sci. U.S.A.;* **76**: No. 2, 862-866(Feb 1979).

The mutagenicity of 7,12-dimethylbenz[a]-anthracene (DMBA) and 11 of its metabolites was tested with Chinese hamster V79 cells. Mutations were characterized by resistance to ouabain and 6-thioguanine. None of the tested metabolites was mutagenic in V79 cells, which do not metabolize polycyclic aromatic hydrocarbons. DMBA, 7-hydroxymethyl-12-methylbenz[a]anthracene, 7-methyl-12-hydroxymethylbenz[a]anthracene, and their trans-3,4-diols were mutagenic for both genetic markers, and the mutagenic response increased as a function of the hydrocarbon dose. All other metabolites were either inactive or showed up to a 4-fold higher mutation frequency than the untreated V79 cells for ouabain and 6-thioguanine resistance. The DMBA-trans-3,4-diol was the only metabolite that was more active than DMBA itself; at 0.05 μM it was 6 to 8 times more active than DMBA.in inducing both ouabain and 6-thioguanine resistance. This diol was mutagenic at a dose as low as 0.01 μM. Mutagenesis by DMBA and the trans-3,4-diols was inhibited by 7,8-benzoflavone, an inhibitor of mixed-function oxidases. Analysis of DMBA metabolism in intact golden hamster cells indicated that DMBA-trans-3,4-diol is one of the major metabolites produced. Our results therefore suggest that DMBA-trans-3,4-diol may be metabolized to a diol-epoxide, presumably the trans-3,4-diol-1,2-epoxide, which may be a major reactive metabolite responsible for DMBA mutagenicity in mammalian cells.

38853 Mutagenicity and tumor-initiating activity of fluorinated derivatives of 7,12-dimethylbenz(a)anthracene. Huberman, E.; Slaga, T.J. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Cancer Res.;* **39**: 411-414(Feb 1979).

7,12-Dimethylbenz(a)anthracene (DMBA) and its 1-, 2-, 5-, and 11-fluoro derivatives were tested to determine their mutagenicity for ouabain resistance in Chinese hamster V79 cells and their tumor-initiating activity in mouse skin. Inasmuch as V79 cells do not metabolize polycyclic aromatic hydrocarbons, mutagenesis was tested both in the presence and in the absence of golden hamster embryo cells capable of metabolizing polycyclic aromatic hydrocarbons. Neither DMBA nor any of the fluorinated derivatives showed mutagenicity for V79 cells in the absence of the golden hamster cells. In the presence of these cells, DMBA and 11-fluoro-DMBA exhibited a comparable mutagenic response that was dose dependent. At a dose as low as 0.01 μm, a 7- to 10-fold increase in the frequency of ouabain-resistant mutants was observed. The other derivatives were either inactive or required more than a 1000-fold higher dose to induce a comparable mutagenic response. Similarly, both DMBA and 11-fluoro-DMBA at 100 nmol initiated tumors in 100% of the tested mice, whereas the other fluorinated derivatives at this dose initiated skin tumors in 15% or less of the treated mice. The average number of papillomas per mouse induced by 1-, 2-, and 5-fluoro-DMBA was more than 100-fold lower than the number induced by DMBA or 11-fluoro-DMBA. These results suggest that carbon positions 1 and 2 of DMBA, which are located at the bay region, and position 5, which is located at the K-region, are involved in the metabolic activation of DMBA into mutagenic and carcinogenic metabolites.

38854 Biochemical basis for the acquisition of resistance to benzo[a]pyrene in clones of mouse liver cells in culture. Landolph, J.R.; Becker, J.F.; Gamper, H.; Bartholomew, J.C.; Calvin, M. (Univ. of California, Berkeley). *Chem.-Biol. Interact.;* **23**: 331-344(1978).

In a Namru mouse liver epithelical cell strain designated NMuLi, aryl hydrocarbon hydroxylase (AHH) activity peaked at 12 h post-induction with 1 μg/ml of benzo(a)pyrene (BaP) in both confluent and growing cells. Maximal levels of AHH activity were reached on day two post-plating. This induced activity was inhibited in vitro 78% by gassing the incubation mixture with carbon monoxide for 15 s, and inhibited 93% by addition of 40 μg/ml of 7,8 benzoflavone(BF). Induced AHH levels were higher in epithelial clones that were sensitive to the toxocity of BaP than in resistant clones. The survival fraction of clones from NMuLi and of subclones derived from a sensitive clone of NMuLi after BaP treatment was a negative exponential function of the maximal induced AHH activity in the clones. One of the clones, NMuLi cl 8, was extremely susceptible to the toxic effects of BaP, the +-(trans)-7α, 8β-dihydroxy-7,8-dihydro-BaP(7,8-diol), and the (+-)-7α,8β-dihydroxy-9β, 10β-epoxy-7,8,9,10-tetrahydro-BaP (diol-epoxide), known metabolites of BaP. The toxicity of BaP and the 7,8 diol to this clone was inhibited by BF, suggesting that these cells possessed an enzyme activity inhibitable by BF that could epoxidize BaP to the 7,8 oxide and then epoxidize the resultant 7,8 diol to the diol-epoxide. Another clone derived from NMuLi, clone 7, was relatively resistant to the toxic effects of BaP and the 7,8-diol, but still extremely susceptible to the toxic effects of the diol-epoxide.

38855 Sister chromatid exchanges induced by inhaled anesthetics. White,A.E.; Takehisa, S.; Eger II, E.I.; Wolff, S.; Stevens, W.C. (Univ. of California, San Francisco). *Anesthesiology;* **50**: No. 5, 426-430(May 1970).

There is sufficient evidence that anesthetics may cause cancer to justify a test of their carcinogenic potential. Baden et al., using the Ames test, a rapid and inexpensive genetic indicator of carcinogenicity, have shown that among currently used anesthetics fluorxene alone caused bacterial mutations. The authors used the sister chromatid exchange (SCE) technique, another rapid assay of mutagenic-carcinogenic potential. The frequency of sister chromatid exchanges in Chinese hamster ovary cells increases when the cell cultures are exposed to mutagen-carcinogens, particulary in the presence of a metabolic activating system. With this test system a one-hour exposure to 1 MAC nitrous oxide, diethyl ether, trichloroethylene, halothane, enflurane, isoflurane, methoxyflurane, or chloroform did not increase SCE values. Divinyl ether, fluroxene and ethyl vinyl ether increased SCE values in the same circumstances. Results of this study of mammalian cells suggest that no currently used anesthetic is a mutagen-carcinogen. The results also suggest that anesthetics containing a vinyl moiety may be mutagen-carcinogens.

MICROORGANISMS

REFER ALSO TO CITATION(S) 38855

38856 (DOE/ET/00222—6) **Exploratory research on mutagenic activity of coal-related materials. Progress report, July 31-September 1, 1980.** Warshawsky, D.; Schoeny, R. (Cincinnati Univ., OH (USA). Kettering Lab.). 1980. Contract AS22-78ET00222. 18p. NTIS, PC A02/MF A01.

Samples ETTM-05 and ETTM-12 (powdered coal) were re-evaluated and found to be marginally mutagenic. Organic solvent fractions prepared from these have also been shown to be slightly mutagenic. Upon fractionation of ETTM-18, a highly active methylene chloride component was noted when assayed with Aroclor-induced S9.

38857 (UCRL—52000-80-9, pp 6-9) **Ecology of a marine petroleum seep.** Sep 1980.

In Energy and Technology Review.

During the 1970s the incidence of oil spills became an issue as offshore drilling and worldwide shipping operations expanded there was concern about the effects of petroleum on marine life and a widespread feeling that the problem should be investigated. To evaluate the effects of oil spills in a marine environment marine life was studied in areas in the Santa Barbara Channel where oil seeps naturally out of the ocean floor. The same kinds of organisms were found subsisting at seep and oil-free sites. Surprisingly, population densities were higher in the vicinity of the seep. It was found that there is more food in the seep than in comparable nonseep areas. Microorganisms that oxidize sulfur and degrade hydrocarbons in the crude oil are used as food by benthic organisms. Some fish have adapted to the crude petroleum in the seep, although there was no evidence of adaptation in one species of starfish studied. Upon first analysis, the seep environment does not appear to be toxic. (Hydrocarbon levels are below the levels at which toxicity can be measured). However, the starfish studied are accumulating hydrocarbons selectively in the digestive and reproductive tissues, the effects of which are unknown. (JGB)

38858 Mode of inhibition of electron transport by orthophenanthroline in chromatophores and reaction centers of Rhodopseudomonas sphaeroides. Vermeglio, A. (Center d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France); Martinet, T.; Clayton, R.K. Contract EY-76S-02-3162. *Proc. Natl. Acad. Sci. U.S.A.;* **77**: No. 4, 1809-1813(Apr 1980).

In Rhodopseudomonas sphaeroides, light causes the transfer of electrons from bacteriochlorophyll to ubiquinone in the photochemical reaction centers. Electrons from this primary ubiquinone move on to a secondary ubiquinone. We have studied the manner in which o-phenanthroline inhibits the transfer of electrons from primary to secondary ubiquinone in chromatophores (intracytoplasmic membrane fragments) and isolated reaction centers of Rp. sphaeroides. The formation of anionic semiquinones, both primary and secondary, is signaled by an absorption band at 450nm and by band shifts of bacteriopheophytin and bacteriochlorophyll in the near infrared. The pattern of band shifts is different for primary and secondary semiquinone, allowing us to distinguish which quinone has become semireduced. This point was established for isolated reaction centers and is confirmed here for chromatophores. By adding o-phenanthro-

line at various times during a sequence of actinic light flashes and monitoring the resulting optical absorbance changes, we have found that o-phenanthroline inhibits electron transfer from primary semiquinone to secondary quinone if the latter is in its oxidized form, but not if the latter is semireduced. Our findings can explain the decay kinetics of delayed fluorescence from bacteriochlorophyll in Rp. sphaeroides as measured by R.P. Carithers and W.W. Parson.

38859 Comparative reactivities of diolepoxide metabolites of carcinogenic hydrocarbons with phiX174 viral DNA. Hsu, W.T. (Franklin McLean Memorial Research Inst., Chicago, IL); Lin, E.J.; Fu, P.P.; Harvey, R.G.; Weiss, S.B. Contract E-76-C-02-0069. *Biochem. Biophys. Res. Commun.;* **88**: No. 1, 251-257(14 May 1979).

The phiX174 DNA assay system developed earlier is utilized to determine the comparative reactivities with nucleic acid of the diolepoxide metabolites of a series of polycyclic aromatic hydrocarbons varying in carcinogenic potency. The infectious phiX174 viral DNA is exposed to the hydrocarbon derivative for 10 min, then infectivity of the treated DNA is assayed by incubation with E. coli spheroplasts, counting plaque formation on agar plates. The bay region diolepoxides of benzo[a]-pyrene, chrysene, and dibenz[a,h]anthracene, implicated as the ultimately active carcinogenic metabolites of the parent hydrocarbons, exhibit potent viral inhibitory activity. On the other hand no correlation is evident between viral inhibitory activity and either the location of the diolepoxide function in a bay region or the theoretically calculated β-delocalization energies (ΔE/sub deloc./) of the carbonium ion arising from opening the epoxide ring. The significance of these findings with respect to theories of carcinogenesis is discussed.

38860 Mutagenicity of coal fly ash from electric power plant precipitators. Kubitschek, H.E.; Venta, L. (Argonne Natl. Lab., IL). *Environ. Mutagen.;* **1**: 79-82(1979).

The earlier work of Chrisp et al showed that stack-collected fly ash carried a low level of mutagenic activity, approximately 30 revertants per milligram. We find, in contrast, that fly ash collected from precipitators of the same kinds of electrical power plants, burning a similar type of coal, are not observably mutagenic in the same assay system. Our results indicate that although precipitator fly ash account for approximately 95% of the fly ash product, it contributes little if at all to the total mutagenic activity of fly ash produced by coal-fired power plants.

PLANTS

38861 (UCRL—52000-80-9, pp 23-29) **Predicting plant damage from air pollution.** Sep 1980.

In Energy and Technology Review.

Before building a power plant, drilling a geothermal well, or developing oil shale resources, it is advisable to know how pollution from the project will affect natural and agricultural ecosystems in the area. Studies on the ways by which air pollutants generated by energy industries affect plant growth and yield were undertaken. The goal of the project is to gather experimental information on the physiological responses of plants to pollutants in the air and to use this data in computer models that predict the impact of proposed energy industries on crops and forests. Studies of ozone-induced changes in the ultrastructure of pine and cotton leaf cells, the effects of various combinations of pollutants on bean plants, and pollutant stress in ponderosa pine in the San Bernandino National Forest near Los Angeles have been completed.

38862 (UCRL—52000-80-9, pp 30-35) **Coal, air pollution, and forests.** Sep 1980.

In Energy and Technology Review.

The development of a computer model (SILVA) that simulates growth and succession patterns in a western conifer forest with and without air pollution over periods of up to 500 years is discussed. According to model predictions, a pollution level that reduces the growth rate of ponderosa pines by 10% will result in their being gradually replaced by the more tolerant (and less valuable) white fir.

38863 Inhibition of flowering in the long-day plant Lemna gibba G3 by Hutner's medium and its reversal by salicyclic acid. Tanaka, O. (Smithsonian Institution Radiation Biology Lab., Rockville, MD); Cleland, C.F.; Hillman, W.S. *Plant Cell Physiol. (Kyoto);* **20**: No. 4, 839-846(1979).

Flowering in the long-day plant Lemna gibba L., strain G3 is poor or absent in Hutner's medium even under continuous light, an effect generally ascribed to the ammonium content of the medium. However, flowering is also inhibited in ammonium-free modifications of Hutner's medium, particularly in the presence of sucrose, but is restored to high levels by the presence of 10 μM salicylic acid. These results link two of the least understood chemical effects in Lemnaceae flowering, and they provide a system in which large effects of salicylic acid can be readily obtained.

38864 Developments in paraquat treatment of trees to induce lightwood formation. Drew, J. (SCM Corp., Jacksonville, FL); Roberts, D.R. *For. Prod. J.;* **27**: No. 7, 43-47(Jul 1977).

From 30. annual meeting of the Forest Products Research Society; Toronto, Ontario, Canada (13 Jul 1976).

Paraquat treatment has induced lightwood formation in all species of pines tested to date, but failed to cause a significant response in firs, spruces, hemlock, and Douglas-fir. In a 40-year-old natural slash pine stand, paraquat concentrations as high as 24 percent caused only slight mortality. Applications of paraquat to live phloem-, cambium-, and xylem-depth wounds all resulted in lightwood formation. After 1-1/2 years of a 2-year study of paraquat treatment of 20-year-old slash pines, the lightwood formation continues to increase with time. A mill trial of 4000 cords of slash pine using paraquat-treated wood at levels up to 25 percent of the total furnish gave no problems in the kraft pulping operations.

38865 Chemically inducing lightwood formation in southern pines. Roberts, D.R.; Peters, W.J. (USDA Forest Service, Olustee, FL). *For. Prod. J.;* **27**: No. 6, 28-30(Jun 1977).

From 29. annual meeting of the Forest Products Research Society; Portland Oregon, USA (19 Jun 1975).

Chemical induction of lightwood formation promises to be a new method of naval stores production. A broad range of paraquat concentrations and many methods of application induced lightwood formation. Loblolly, slash, and longleaf pines were found to produce increased amounts of turpentine and tall oil in response to paraquat treatment. In one experiment, loblolly pines treated with 8 percent paraquat on a single bark streak yielded, 9 months after treatment, an average of 10 pounds more extractives per tree than did untreated trees. Most of the yield increase was in the lower portion of the tree near the wound, but some increase was noted for heights as great as 27 ft. In another experiment, 8 to 10 inch DBH loblolly, slash, and longleaf pine trees were treated with 0.5, 1.0, and 2.5 percent paraquat applied in ax chops spanning one-third the circumference of the trees. All treated trees yielded more resin acids than did control trees.

38866 Stimulation of photosynthesis by carbonyl compounds and chelators. Crane, F.L.; Barr, R. (Purdue Univ. West Lafayette, IN). *Biochem. Biophys. Res. Commun.;* **74**: No. 4, 1362-1368(1977).

A number of carbonyl compounds including bicarbonate, ethylene carbonate, dimethylcarbonate, propylene carbonate, bispentamethylene urea, and glycidol, and several chelators were tested for their effect on photosynthetic reactions in isolated spinach chloroplasts. It was found that carbonyl compounds inhibited the DCMU-insensitive silicomolybdate reduction by photosystem II but stimulated the 0_2 evolution associated with ferricyanide reduction in presence of DBMIB and the $H_20 \rightarrow$methylviologen reaction. Many chelators behaved in the same maner except 1,10-phenanthroline which shows the opposte effect. The carbonyl compounds did not uncouple because they stimulated the proton gradients associated with noncyclic photophosphorylation, whereas some chelators, such as bathocuproine or bathophenanthroline inhibited the proton gradients 100%. Electron transport in presence of ADP and inorganic phosphate showed a stimulation of rates beyond that obtained in presence of an uncoupler. The data are discussed in terms of inhibition of cyclic electron flow around PS II which leads to inreased electron transport rates toward PS I.

INVERTEBRATES

REFER ALSO TO CITATION(S) 38693, 38857

38867 (UCRL—52000-80-9, pp 2-5) **Effects of copper on aquatic organisms.** Sep 1980.

In Energy and Technology Review.

The sensitivity of aquatic organisms to different classes of pollutants is being evaluated as part of a larger study of the hazards associated with various energy technologies. The overall objective is to find ways of minimizing the impact of energy-related pollutants on the environment. One pollutant of concern is copper (found in corrosion products in the water that flows from some power-plant cooling systems). The sensitivity of various marine and freshwater organisms to copper was measured and both lethal and sublethal effects were evaluated. Sublethal effects of high-level exposure in early life stages include an increase in the number of abnormal larvae in the exposed population, a reduction in the number of embryos that hatch, and a decrease in size at hatching. In adult stages, increased concentrations of copper in tissues, changes in oxygen consumption, and modified behavior patterns were found. Sublethal exposures to certain toxicants seem to increase the incidence of sister chromatid exchange in the somatic cells of marine worms and mussels, and exposure of abalone to increasing concentrations of copper increases variability in the DNA of sperm cells. Results indicate that chronic, low-level exposure to copper results in the accumulation of copper in metallothionein-like proteins (thought to be crucial to the natural detoxification defenses of organisms). Evidence was also found that

copper affects the stability of lysosomal membranes and thus alters the availability of the enzymes β-glucuronidase and β-glucosaminidase found in the lysosome.

38868 Sensitivity of Drosophila melanogaster to low concentrations of gaseous mugagens. II. Chronic exposures. Kale, P.G.; Baum, J.W. (Brookhaven National Lab., Upton, NY). *Mutat. Res.;* **68**: 59-68(1979).

Sex-linked recessive lethal mutations were induced in Drosophila melanogaster males by gaseous 1,2-dibromoethane at concentrations ranging from 0.2 to 2 parts per million. Significant numbers of mutations could be induced at all these concentrations. Pronounced germ-cell sensitivity differences were observed. For low exposures, spermatids and spermatocytes were about 10 to 20 times more sensitive than spermatozoa. The dose-effect relation was linear below 60 ppM.h for the 3 cell types. At higher exposures, sterility prevented mutation detection in spermatocytes and in spermatogonia. The lowest effective exposure for spermatozoa was 18 ppM.h (0.25 ppM for 72 h). In spermatids, the lowest exposure tested, 2.3 ppM.h (0.2 ppM for 11 h) induced 4 times the spontaneous mutation rate. Therefore, using prolonged exposure periods one may be able to detect concentrations in the range of parts per billion. Thus, Drosophila appears suitable as a system for detecting very low concentrations of gaseous mutagens in industrial, agricultural and environmental atmospheres.

38869 Sensitivity of Drosophila melanogaster to low concentrations of the gaseous 1,2-dibromoethane. I. Acute exposures. Kale, P.; Baum, J.W. (Brookhaven National Lab., Upton, NY). Contract EY-76-C-02-0016. *Environ. Mutagen.;* **1**: 15-18(1979).

Drosophila melanogaster males were exposed to gaseous 1,2-dibromoethane at concentrations lower than those used in aerosol treatments of suspected mutagens by other investigators. Premeiotic stages appear to be more sensitive than postmeiotic stages to gaseous mutagens. At an exposure of 125 ppM.h, significant number of mutations were induced in spermatids, spermatocytes, and spermatogonia. Since this exposure increased the mutation rate in spermatogonial stages by a factor of 20 to 40 over the spontaneous rate, it appears that the lowest detectable exposures may be much lower than 125 ppM.h for 1,2-dibromoethane.

38870 Response of microarthropod populations to naphthalene in three contrasting habitats. Best, G.R. (Univ. of Georgia, Athens); Nabholz, J.V.; Ojasti, J.; Crossley, D.A. Jr. *Pedobiologia;* **18**: 189-201(1978).

A field experiment was designed applying four concentrations of naphthalene to litter of three habitats: an old field, a pine forest, and a hardwood forest. Treatment lasted 8 days. Naphthalene acted like an insecticide: affecting all major groups of litter microarthropods and causing a logarithmic reduction in their densities. These reductions were apparently the result of mortality and not horizontal or vertical emigration.

VERTEBRATES

REFER ALSO TO CITATION(S) 38805, 38823, 38867

38871 Studies on the mechanism of skin tumor promotion: evidence for several stages in promotion. Slaga, T.J.; Fischer, S.M.; Nelson, K.; Gleason, G.L. (Oak Ridge National Lab., TN). *Proc. Natl. Acad. Sci. U.S.A.;* **77**: No. 6, 3659-3663(Jun 1980).

The effects of nonpromoting and weakly promoting diterpenes on skin tumor promotion by 12-O-tetradecanoylphorbol 13-acetate (TPA) were investigated. When phorbol and phorbol 12,13-diacetate (both nonpromoting) were given simultaneously with TPA after 7,12-dimethylbenz[a]-anthracene (DMBA) initiation in female mice, they had no effect on TPA promotion. However, the nonpromoter 4-O-methyl-TPA and the weak promoter mezerein were found to inhibit TPA promotion in a dose-dependent manner when given simultaneously with TPA. Because mezerein was found to be an effective inhibitor of TPA promotion when given simultaneously and because it induces many biological responses similar to those to TPA, the capacity of mezerein to act as an incomplete promoter in a two-stage promotion protocol was also investigated. The results suggest that although mezerein by itself is a weak promotor and mimics TPA in many biochemical and morphological effects it is a potent second-stage promoter in a two-stage promotion regimen.

38872 Cytogenetic effects of inhaled benzene in murine bone marrow: induction of sister chromatid exchanges, chromosomal aberrations, and cellular proliferation inhibition in DBA/2 mice. Tice, R.R.; Costa, D.L.; Drew, R. T. (Brookhaven National Lab., Upton, NY). Contract EY-76-C-02-0016. *Proc. Natl. Acad. Sci. U.S.A.;* **77**: No. 4, 2148-2152(Apr 1980).

Exposure of adult male and female DBA/2 mice to 3100 ppM benzene for 4 hr significantly increased the frequency of sister chromatid exchanges in bone marrow cells of both sexes, inhibited marrow cellular proliferation (but only in male mice), and did not significantly increase the frequency of chromosomal aberrations in either sex. Phenobarbital pretreatment synergistically interacted with benzene exposure to further increase sister chromatid exchanges in female mice, induce greater inhibition of cellular proliferation in male mice, and induce a significant level of chromatid-type chromosomal aberrations in both sexes. During the second day after exposure to benzene there was increased inhibition of cellular proliferation in male mice and both new DNA damage and persistence of old DNA damage in female mice. The differences in both the type and magnitude of the response of bone marrow cellular populations, as determined by different cytogenetic end points in male and female DBA/2 mice exposed to benzene or to phenobarbital and benzene, suggest not only that a metabolite of benzene is responsible for the observed effects, but that different metabolites may be involved in different end points.

38873 Apparent rat strain related sensitivity of phorbol promotion of mammary carcinogenesis. Shellabarger, C.J.; Holtzman, S.; Stone, J.P. (Brookhaven National Lab., Upton, NY). Contract EY-76-C-02-0016. *Cancer Res.;* **39**: 3345-3348(Jul 1979).

In an experiment reported here, in female Sprague-Dawley rats, using twice-weekly i.p. injections of 4 mg phorbol for 10 weeks, after a single feeding of 6 mg dimethylbenz(s)anthracene (DMBA) in female Wister rats, it was found that phorbol given after DMBA did not augment mammary adenocarcinoma incidence or lymphatic leukemia incidence as compared to DMBA given alone. It thus appears that there is a strain-related sensitivity between Wistar and Sprague-Dawley rats with regard to the promoting activity of phorbol when phorbol treatment follows DMBA treatment, and mammary adenocarcinoma incidence and lymphatic leukemia incidence are studied. Further, in Sprague-Dawley rats, phorbol did not promote mammary fibroadenoma incidence in DMBA-treated rats, mammary adenocarcinoma incidence in procarbazine-treated rats, and mammary adenocarcinoma incidence or mammary fibroadenoma incidence in x-ray-treated rats. DMBA and procarbazine, with or without phorbol, tended to induce more mammary neoplasms in the thoracic than in the abdominal mammary glands. X-irradiation tended to induce mammary neoplasms in approximately equal numbers in the anterior and posterior mammaryglands. It was suggested that regional differences in chemically induced mammary carcinogenesis were due to a difference in the transport and delivery of the chemical carcinogens to the regions rather than a difference in the amount of mammary gland tissue in the regions. An analysis suggested that the development of a mammary adenocarcinoma fibroadenoma are independent processes.

38874 Effects of water-soluble chlorine-containing organics on aquatic environments - another perspective. Trabalka, J.R.; Burch, M.B. (Oak Ridge National Lab., TN). *Toxicol. Lett.;* **3**: 201-207(1979).

Many water-soluble chlorine-containing organic compounds of low volatility have been identified in chlorinated cooling waters and sanitary effluents. Relatively little is known about the ecological effects of these materials in aquatic systems. Earlier results which indicated toxicity of two compounds, 5-chlorouracil and 4-chlororesorcinol, to carp embryos at concentrations $<<$ 1 mg/l are refuted by our research. Our investigations support more recent work indicating either relatively low or moderate toxicity ($LC_{50}>$ 10 to 100 mg/l) for these compounds and representative chlorinated effluents which contain them. Toxicity of three synthetic mixtures of identified chlorinated organics can be attributed primarily to the content of chlorophenols.

38875 Effects of three diets on mercury excretion after methylmercury administration. Landry, T.D.; Doherty, R.A.; Gates, A.H. (Univ. of Rochester, NY). *Bull. Environ. Contam. Toxicol.;* **22**: 151-158(1979).

In contrast to adults, suckling mice excrete minimal amounts of their mercury body burdens until the approximate time of weaning to a solid diet, when there is an abrupt increase in mercury elimination. Increased gut absorption of inorganic Hg in rats fed a milk diet has been reported. These observations suggest that dietary components may influence absorption and excretion of Hg compounds. This possibility was examined by determining the effects of (1) an evaporated whole milk diet, (2) a chemically defined liquid diet, and (3) a pelleted rodent diet on Hg retention in mice after administration of an apparently non-toxic dose of methylmercury (MeHg). Whole body Hg elimination and fecal and urinary Hg excretion were measured daily for two weeks. Two weeks after MeHg administration, Hg concentrations in whole body, brain, liver, kidney and whole blood were determined. The diet groups showed differences in whole body Hg retention and fecal Hg excretion.

38876 Cadmium-binding in the pregnant and fetal rat. Kelman, B.J.; Ozga, J.A.; Walter, B.K.; Sasser, L.B. (Comparative Animal Research Lab., Oak Ridge, TN). *Toxicol. Lett.;* **4**: 135-141(1979).

A cadmium-binding moiety with properties in common with adult cadmium-thionein was identified in the livers of fetal rats at day 18 of gestation. Pregnant rats (approx. 200 g) were subcutan-

eously injected with 50 μg of radiolabeled cadmium in the form of / sup 115m/$CdCl_2$ daily from days 11 through 15 of gestation. Maternal liver contained 14 to 18 μg Cd/g tissue; fetal liver contained 44 to 70 ng Cd/g tissue. A soluble (aqueous), heat stable, cadmium-binding molecule(s) was found which had an apparent molecular weight of approx. 10,000 in adult livers and 6000 in fetal livers by gel filtration chromatography. Both fetal and adult proteins absorbed maximally at 254 but not 280 nm.

MAN

REFER ALSO TO CITATION(S) 38833, 38849

38877 (DOE/ET/25405—1) **Chlorine hazard evaluation for the zinc-chlorine electric vehicle battery. Final technical report.** Zalosh, R.G.; Bajpai, S.N.; Short, T.P.; Tsui, R.K. (Factory Mutual Research Corp., Norwood, MA (USA)). Apr 1980. Contract AC02-78ET25405. 167p. NTIS, PC A08/MF A01.

An evaluation of the hazards associated with conceivable accidental chlorine releases from zinc-chlorine electric vehicle batteries is presented. Since commercial batteries are not yet available, this hazard assessment is based both on theoretical chlorine dispersion models and small-scale and large-scale spill tests with chlorine hydrate. Six spill tests involving chlorine hydrate indicate that the danger zone in which chlorine vapor concentrations intermittently exceed 100 ppM extends at least 23 m directly downwind of a spill onto a warm road surface. Chlorine concentration data from the hydrate spill tests compare favorably with calculations based on a quasi-steady area source dispersion model and empirical estimates of the hydrate decomposition rate. The theoretical dispersion model has been combined with assumed hydrate spill probabilities and current motor vehicle accident statistics in order to project expected chlorine-induced fatality rates. These calculations indicate that expected chlorine fatality rates are several times higher in a city with a warm and calm climate than in a colder and windier city. Calculated chlorine-induced fatality rate projections for various climates are presented as a function of hydrate spill probability in order to illustrate the degree of vehicle/battery crashworthiness required to maintain chlorine-induced fatality rates below current vehicle fatility rates due to fires and asphyxiations.

38878 (EPA—600/7-79-167a, pp 21-47) **Health effects of SO_2 and sulfates.** Carnow, B.W.; Bouchard, E. (Univ. of Illinois, Chicago). Jul 1979.

From 5. flue gas desulfurization symposium; Las Vegas, NV, USA (5 Mar 1979).

There is not health justification for relaxing present SO_2 ambient standards, nor is there likely to be. Moreover, present SO_2 standards may not be protecting high risk groups and hypersensitive individuals. While the data base on sulfates from epidemiologic studies is insufficient, animal and human toxicologic studies have shown that many sulfates are unquestionably considerably more toxic than sulfur dioxide. There is also no question that there is a build-up of sulfates in the air of certain regions of the US, notably the Northeast. It also appears that sulfur dioxide levels are not a good measure of ambient sulfates. For these reasons it is clear that a separate sulfate standard is desirable to protect health. Since adverse health effects were observed at levels of 8 to 10 $\mu g/m^3$, it would be prudent to promulgate a temporary standard, possible at half of that or of 4 $\mu g/m^3$ annual mean, not to be exceeded more than one percent of the time during the course of a year. Reductions of ozone and particulate, which appear to act synergestically with SO_2, might result in reduced negative health effects of all 3 pollutants. Additional toxicologic and epidemiologic research on possible mutagenic, carcinogenic and cocarcinogenic effects of SO_2, sulfates, sulfites and bisulfites is indicated.

38879 (HRP—0030185/3) **Health effects of air pollution.** Shy, C.M.; Goldsmith, J.R.; Hackney, J.D.; Lebowitz, M.D.; Menzel, D.B. (American Thoracic Society, New York. Scientific Assembly on Environmental and Occupational Health). 1978. 78p. Available from American Lung Association, 1740 Broadway, New York, NY 10019.

This discussion, which is directed to informed laymen, physicians, and the staff and volunteers of the American Lung Association and its constitutents, is meant to outline the available knowledge about the effects of air pollution on human health. Particular attention is given to the respiratory system. Following an introductory section dealing with the purpose and scope of the monograph, the discussion turns to the effects of air pollution on human populations. Evidence that exposure to air pollution has been associated with excess mortality, acute and chronic respiratory disease, disturbances in ventilatory function, asthma, heart disease, sensory and central nervous system effects, and tissue residues is presented. Subsequent material is concerned with the health effects and mechanisms of action of specific air pollutants on affected organ systems and issues associated with the assessment of human health risks of exposure to air pollution. Examples of efforts to evaluate overall health risks are provided. A 403-item bibliography accompanies the text.

38880 (PB—80-129083) **Low-level carbon monoxide exposure and work capacity at 1600 meters.** Weiser, P.C.; Cropp, G.J.A.; Morrill, C.G.; Kurt, T.L.; Dickey, D.W. (National Asthma Center, Denver, CO (USA). Dept. of Physiology). Sep 1979. Contract EPA-68-02-2244. 35p. NTIS, PC A03/MF A01.

At sea level, low-level carbon monoxide (CO) exposure impairs exercise performance. To determine if altitude residence at 1600 m augments this CO effect, two studies of graded treadmill work capacity were done. The Initial Study investigated nine, nonsmoking male subjects breathing either filtered air (FA) or 28 ppm CO in filtered air. End-exercise carboxyhemoglobin (HbCO) levels averaged 0.9 %HbCO breathing FA and 4.7 %HbCO breathing CO. Total work performance and aerobic work capacity were reduced. Work heart rate was elevated, and post-exercise left ventricular ejection time breathing CO did not shorten to the same degree as with FA exposure. CO exposure resulted in a lower anaerobic threshold, and a greater minute ventilation occurred at work rates heavier than the anaerobic threshold due to an increased blood lactate level. The Dose-Response Study exposed twelve subjects to FA or CO such that the end-exercise HbCO levels were 0.7, 3.5, 5.4 and 8.7 %HbCO. Exercise performance and aerobic work capacity were impaired in proportion to the CO exposure. In both studies, maximal cardio-pulmonary responses were not different, but submaximal exercise changes were elevated breathing CO. Thus, in healthy young men residing near 1600 m, an increase in low-level CO exposure produced a linear decrement in maximal aerobic performance similar to that reported at sea level.

38881 **Interaction of human DNA polymerase β with ions of copper, lead, and cadmium.** Popenoe, E.A.; Schmaeler, M.A. (Brookhaven National Lab., Upton, NY). Contract EY-76-C-02-0016. *Arch. Biochem. Biophys.;* **196**: No. 1, 109-120(Aug 1979).

Under appropriate conditions, divalent copper, lead, and cadmium ions significantly inhibit human DNA polymerase β (following accepted convention, the term DNA polymerase β refers to the low-molecular-weight, 3 to 4 S DNA polymerase of eukaryotic cells) at concentrations below 10^{-5} M. Each metal showed apparent linear noncompetitive inhibition kinetics with respect to the template primer and the deoxynucleoside triphosphate substrate, indicating that complex formation with these components does not account for the inhibition. Apparently, neither lead nor cadmium inhibits by displacing required zinc atoms from the polymerase. The interaction of the metals with the enzyme can be reversed or prevented by EDTA or by thiol compounds, except that inhibition by cadmium ions can be reversed by monothiols but not by dithiols. The metals probably do not inhibit through reaction with thiol groups since the inhibition is not decreased by pretreating the enzyme with N-ethylmaleimide. Although divalent zinc is moderately inhibitory in manganese activated poly(dT) synthesis on a poly(dA) template, it can fill the requirement for a divalent metal ion and, under the conditions tested, is about 60% as effective as Mn^{2+}.

38882 **Stimulation of differentiated functions in human melanoma cells by tumor-promoting agents and dimethyl sulfoxide.** Huberman, E.; Heckman, C.; Langenbach, R. (Oak Ridge National Lab., TN). Contract W-7405-ENG-26. *Cancer Res.;* **39**: 2618-2624(Jul 1979).

Treatment of cultured human HO melanoma cells with the mouse skin tumor promoter phorbol-12-myristate-13-acetate (PMA) at 5 x 10^{-10} to 5 x 10^{-7} M resulted in a dose-related inhibition of growth and a stimulation of differentiated functions. These included melanin synthesis and formation of dendrite-like structues. Higher doses of phorbol dibutyrate, a less potent tumor promoter, were required to produce an effect comparable to that of PMA for dendrite induction. Phorbol and two other phorbal esters, which lack tumor-promoting activity, were either inactive or elicited a poor response. In addition to morphological changes, treatment with PMA altered glucosamine incorporation into membrane gangliosides. After PMA treatment, glucosamine incorporation increased 8- to 10 fold in the G/sub m3/ ganglioside and decreased 2-fold in the G/sub m1/ ganglioside, as compared to phorbol or untreated control. Inhibition of cell growth and stimulation of melanin synthesis were also observed after treatment of the HO cells with dimethyl sulfoxide. Unlike the tumor-promoting agents, dimethyl sulfoxide did not induce the formation of dendrite-like structures in the cells. These findings indicate that HO melanoma cells can be stimulated into terminally differentiated cells after treatment with tumor-promoting agents such as phorbol diesters.

OTHER ENVIRONMENTAL POLLUTANT EFFECTS

38883 (RDA—80-8122) **Microwave hazard instruments: an evaluation of the Narda 8100, Holaday HI-1500, and Simpson 380M.** Herman, W.A.; Witters, D.M. Jr. (Bureau of Radiological Health,

Rockville, MD (USA). Div. of Electronic Products). Jun 1980. 43p. GPO.

A set of 13 parameters most likely to have significant impact on the accuracy of microwave oven survey meters was devised. Measurement systems and protocols were developed and evaluated. The resulting techniques were used to evaluate widely used survey meters produced by three manufacturers. The results of these evaluations are presented, along with additional analyses of problems generic to such survey instruments.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 38708, 38846, 38883

38884 (DP-MS—80-81) **Automated emergency meteorological response system.** Pepper, D.W. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1980. Contract AC09-76SR00001. 25p. (CONF-801122—1). NTIS, PC A02/MF A01.

From National Petroleum Refiners Association conference; Philadelphia, PA, USA (16 Nov 1980).

A sophisticated emergency response system was developed to aid in the evaluation of accidental releases of hazardous materials from the Savannah River Plant to the environment. A minicomputer system collects and archives data from both onsite meteorological towers and the National Weather Service. In the event of an accidental release, the computer rapidly calculates the trajectory and dispersion of pollutants in the atmosphere. Computer codes have been developed which provide a graphic display of predicted concentration profiles downwind from the source, as functions of time and distance.

38885 (LA-UR—80-2160) **Automated medical information system of the Los Alamos Scientific Laboratory.** Eagan, G.D.; Grier, R.S. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 5p. (CONF-801109—1). NTIS, PC A02/MF A01.

From Symposium on computer applications in medical care; Washington, DC, USA (7 Nov 1980).

The Medical Information System (MIS) at the Los Alamos Scientific Laboratory automates the acquisition, storage, and retrieval of medical information concerning the nine thousand project-connected personnel. The MIS incorporates an on-line, interactive medical history questionnaire, mark sense form processing, and automated coronary risk assesment in the medical evaluation process. Also, MIS has created the ability for long-term study and comparison of employee health as well as made the physician's time more effective.

38886 (PNL—3376) **Assessment of the risk of transporting liquid chlorine by rail.** Andrews, W.B. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Mar 1980. Contract AC06-76RL01830. 189p. NTIS, PC A09/MF A01.

This report presents the risk of shipping liquid chlorine by rail. While chlorine is not an energy material, there are several benefits to studying chlorine transportation risks. First, chlorine, like energy materials, is widely used as a feedstock to industry. Second, it is the major purification agent in municipal water treatment systems and therefore, provides direct benefits to the public. Finally, other risk assessments have been completed for liquid chlorine shipments in the US and Europe, which provide a basis for comparison with this study. None of the previous PNL energy material risk assessments have had other studies for comparison. For these reasons, it was felt that a risk assessment of chlorine transportation by rail could provide information on chlorine risk levels, identify ways to reduce these risks and use previous studies on chlorine risks to assess the strengths and weaknesses of the PNL risk assessment methodology. The risk assessment methodology used in this study is summarized. The methodology is presented in the form of a risk assessment model which is constructed for ease of periodic updating of the data base so that the risk may be reevaluated as additional data become available. The report is sectioned to correspond to specific analysis steps identified in the model. The transport system and accident environment are described. The response of the transport system to accident environments is described. Release sequences are postulated and evaluated to determine both the likelihood and possible consequences of a release. Supportive data and analyses are given in the appendices. The risk assessment results are related to the year 1985 to allow a direct comparison with other reports in this series.

GEOSCIENCES

GEOLOGY AND HYDROLOGY

REFER ALSO TO CITATION(S) 37648, 37649, 37650, 37736, 37742

38887 (LBL—9677-2/2) **Study of rock-water-nuclear waste interactions in the Pasco Basin, Washington: Part II. Preliminary equilibrium-step simulations of basalt diagenesis.** Benson, L.V.; Carnahan, C.L.; Che, M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1980. Contract W-7405-ENG-48. 31p. NTIS, PC A03/MF A01.

Interactions between a large number of complex chemical and physical processes have resulted in significant changes in the Pasco Basin hydrochemical system since emplacement of the first basalt flow. In order to perform preliminary simulations of the chemical evolution of this system, certain simplifying assumptions and procedures were adopted and a computer model which operates on the principal of local equilibrium was used for the mass transfer calculations. Significant uncertainties exist in both the thermodynamic and reaction rate data which were input to the computer model. In addition, the compositional characteristics of the evolving hydrochemical system remain largely unknown, especially as a function of distance along the flow path. Given these uncertainties, it remains difficult to assess the applicability of the equilibrium-step approach even though reasonable matches between observed and simulated hydrochemical data were obtained. Given the uncertainties mentioned, the predictive abilities of EQ6 are difficult, if not impossible to evaluate; our simulations produced, at best, only qualitative agreement with observed product mineral assemblages and sequences, and fluid compositions.

38888 (RHO-BWI-SA—44) **Sedimentology and depositional environment of the Touchet Beds, Walla Walla River Basin, Washington.** Bjornstad, B.N. (Rockwell International Corp., Richland, WA (USA). Energy Systems Group). Jun 1980. Contract AC06-77RL01030. 118p. NTIS, PC A06/MF A01.

The study provides more detailed information, quantitative as well as qualitative, on the sedimentary structure, grain size distribution, and mineralogy in the Touchet Beds. In addition, an attempt is made to reconstruct the environment of deposition based on the sedimentological data. The Touchet Beds are restricted to the slackwater environments of the Columbia Plateau where water accumulated in backflooded valleys associated with Pleistocene catastrophic flooding. Grain size analysis reveals Touchet Beds, also referred to as rhythmites, to be fine-skewed, leptokurtic, graded mixtures of silt and sand. Lower beds in Touchet Bed cyclic sequences often contain coarser flood gravel and sand. Sorting within rhythmites generally decreases upward with the grain size. Mineralogical analysis indicates that the foreign non-basalt fraction in Touchet Beds was transported from areas north and east of the Columbia Plateau, consistent with the inferred flood directions.

MINERALOGY, PETROLOGY, AND ROCK MECHANICS

REFER ALSO TO CITATION(S) 37596, 37619, 37636, 37638, 37744, 38040

38889 (CONF-800750—, pp 111-123) **Effects of temperature and pressure on permeability.** Gobran, B.D.; Sufi, A.H.; Sanyal, S.K.; Brigham, W.E. (Stanford Univ., CA). Sep 1980.

From Meeting for DOE enhanced oil recovery project; San Francisco, CA, USA (22 Jul 1980).

The absolute permeability of confined Ottawa sand to water has been measured as a function of temperature and confining pressure. The flowrate-viscosity product of the core efflux is measured and used in the calculation of permeability. By analyzing the errors inherent in the equipment and the measuring techniques, we have shown a temperature dependence that is significantly greater than experimental error.

38890 (CONF-7710237—) **Proceedings of the seventeenth Muskeg research conference.** Willams, G.P.; Curran, J. (National Research Council of Canada, Ottawa, Ontario. Associate Committee on Geotechnical Research). May 1978. 194p. NTIS (US Sales Only), PC A09/MF A01.

From 17. muskeg research conference; Saskatoon, Canada (4 Oct 1977).

The proceedings of a conference on geotechnical aspects of peat are presented. The behavior of peat in response to static and dynamic stress testing is discussed. Also presented are papers dealing with problems encountered in the use of peat lands as load-bearing strata under structures and highways. (ACR)

38891 (ONWI—100) **Mechanical behavior of Avery Island Halite: a preliminary analysis.** Carter, N.L.; Hansen, F.D. (RE/SPEC, Inc., Rapid City, SD (USA)). Jan 1980. Contract AC06-76RL01830. 37p. NTIS, PC A03/MF A01.

Nine specimens of dome salt from Avery Island were studied to obtain preliminary fabric, deformation mechanism, and mechanical data. The fabric study showed that this salt is comprised primarily of small strain-free halite grains. The salt is unusually clean. The fabric patterns are typical of dome salts. They have moderate a - axes concentrations parallel to the core axis that spread into girdles. Deformation mechanisms were studied using optical microscopy. At low temperatures (24°C to 70°C), cataclasis dominates the deformation while at higher temperatures (to 200°C), plastic flow is predominant. Results of constant stress-rate experiments show that strength increases with increasing stress rate and decreasing temperature. Data from creep tests are fit to several constitutive laws that prescribe deformation during transient and steady-state creep as functions of stress, temperature, and time.

38892 (SAND—79-1773) **Predicted temperature/time histories resulting from the burial of nuclear waste canisters in bedded salt.** George, O.L. Jr. (Sandia National Labs., Albuquerque, NM (USA)). Jul 1980. Contract AC04-76DP00789. 61p. NTIS, PC A04/MF A01.

This report provides computed thermal mappings for bedded salt surrounding canisters containing nuclear waste. This information can be used to study the possible migration of fluids within bedded salt under the influence of thermal gradients created by the heat-generating nuclear waste. The results presented were obtained from CINDA thermal models. Three different drift/canister configurations were modeled. The thermal conductivity of the salt was assumed to be temperature dependent while both the density and specific heat were assumed to be constant. Thermal power densities of 30, 75, and 150 kW/acre were examined with canister powers of 0.581 kW (51.6 canisters/acre), 3.5 kW (21.4 canisters/acre), and 3.5 kW (42.9 canisters/acre) at emplacement, respectively. These three cases resulted in maximum salt temperatures of 55°C, 117°C, and 176°C, respectively; and maximum thermal gradients of -15°C/m, -63°C/m, and -101°C/m, respectively. Computer-generated plots of temperature versus distance in horizontal planes at the top, midpoint, and bottom of the canister were made for several times after emplacement. Logarithmic or linear equations (whichever provided the better fit) were used to describe these curves. Derivatives of temperature with respect to distance were then taken and results of the form x(dT/dx) and dT/dx for the logarithmic and linear equations, respectively, were plotted against time. For the two cases where the waste thermal outputs decayed exponentially, it was found that x(dT/dx) and dT/dx were linear functions of time over a large period of years.

38893 (SAND—79-2230) **Far-field thermomechanical response of argillaceous rock to emplacement of a nuclear-waste repository.** McVey, D.F.; Thomas, R.K.; Lappin, A.R. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1980. Contract AC04-76DP00789. 49p. NTIS, PC A03/MF A01.

Before heat-producing wastes can be emplaced safely in any argillaceous rock, it will be necessary to understand the far-field thermal and thermomechanical response of this rock to waste emplacement. This report presents the results of a first series of calculations aimed at estimating the far-field response of argillite to waste emplacement. Because the thermal and mechanical properties of argillite are affected by its content of expandable clay, its behavior is briefly compared and contrasted with that of a shale having the same matrix thermal properties, but containing no expandable clay. Under this assumption, modeled temperatures are the same for the two rock types at equivalent power densities and reflect the large dependence of in-situ temperatures on both initial power density and waste type. Thermomechanical calculations indicate that inclusion of contraction behavior of expandable clays in the assumed argillite thermal expansion behavior results, in some cases, in generation of a large zone in and near the repository that has undergone volumetric contraction but is surrounded by uniformly compressive stresses. Information available to date indicates that this contraction would likely result in locally increased fluid permeability and decreased in-situ thermal conductivity, but might well be advantageous as regards radionuclide retention, because of the increased surface area within the contracted zone. Assumption of continuous and positive expansion behavior for the shale eliminates the near-repository contraction and tensional zones, but results in near-surface tensional zones directly above the repository.

38894 **Petrogenetic relationship between Allan Hills 77005 and other achondrites.** McSween, H.Y. Jr. (Univ. of Tennessee, Knoxville); Stolper, E.M.; Taylor, L.A.; Muntean, R.A.; O'Kelley, G.D.; Eldridge, J.S.; Biswas, S.; Ngo, H.T.; Lipschutz, M.E. Contract W-7405-ENG-26. *Earth Planet. Sci. Lett.;* **45**: 275-284(1979).

Allan Hills (ALHA) 77005 is a newly discovered, unique achondrite from Antarctica. Petrologic similarities with the shergottites in terms of mineralogy, oxidation state, inferred source region composition, shock metamorphic effects and shock ages suggest a genetic relationship. Volatile to involatile element ratios (e.g. K/U, Rb/U, Cs/U, Tl/U) and abundances of other trace elements support this hypothesis. ALHA 77005 may be a cumulate that crystallized from a liquid parental to those from which the shergottites crystallized; alternatively it may be a sample of the type of source peridotite from which shergottite parent liquids were derived by partial melting. Chemical similarities with terrestrial ultramafic rocks suggest that this unique meteorite provides an additional sample of the only other solar system body known to have basalt source regions chemically similar to the upper mantle of the Earth.

38895 **Geology of carbonate porosity.** Tulsa, OK; American Association of Petroleum Geologists (1979). 253p. (NP—25135).

Separate abstracts were prepared for all five papers. (DLC)

38896 **Porosity in carbonate rock sequences.** Moore, C.H. Jr. pp 124p, Paper A of Geology of carbonate porosity. Tulsa, OK; American Association of Petroleum Geologists (1979).

This paper is divided into 3 parts: use of depositional model strategy to predict favorable reservoir trends in carbonate rock sequences; fate of primary carbonate porosity during and after burial-diagenetic constraints on depositional model strategy; and evolution of carbonate porosity in diagenetic environmental framework. (DLC)

38897 **Secondary carbonate porosity.** Bebout, D.G. (Univ. of Texas, Austin). pp 69p, Paper B of Geology of carbonate porosity. Tulsa, OK; American Association of Petroleum Geologists (1979).

Three reprints are included, relating to secondary carbonate porosity in the Stuart City Trend of Texas, the Zelten Field of Libya, and the Gulf Coast lower Tertiary Frio formation. Some conclusions resulting from the three studies are summarized. (DLC)

38898 **Dolomite reservoir rocks: processes, control, porosity development.** Davies, G.R. (Applied Geoscience and Technology, Calgary, Alberta). pp 17p, Paper C of Geology of carbonate porosity. Tulsa, OK; American Association of Petroleum Geologists (1979).

Dolomitization of pre-existing limestones commonly enhances permeability and improves porosity. Dolomite rocks far outweigh limestones as the major carbonate reservoir rocks in North America. Dolomitization patterns are controlled by paleogeographic setting and distribution, exposure at unconformities, timing of eustatic or tectonic fluctuations, and relation to water tables. (DLC)

38899 **Porosity prediction in shallow versus deep water limestones: primary porosity preservation under burial conditions.** Scholle, P.A. pp 12p, Paper D of Geology of carbonate porosity. Tulsa, OK; American Association of Petroleum Geologists (1979).

Porosity predictions of shallow-water carbonates require many samples and extensive study. Deep-water carbonate rocks are simpler systems, which are amenable to longer-range porosity predictions based on data from other basins, thus requiring fewer samples. (DLC)

GEOCHEMISTRY

REFER ALSO TO CITATION(S) 37660

38900 (ORNL—5665, pp 34-60) **Aqueous chemistry and geosciences.** Jul 1980.

In Chemistry Division annual progress report, February 29, 1980.

Topics studied included aqueous systems (thermodynamics of electrolytes, cation hydrolysis, solubility of amorphous silica, K_2HPO_4 - H_2O), geosciences (high-temperature/pressure silicate, dissociation of carbonic acid, silica deposition), adsorption of inorganic materials on minerals, miscibilities of aqueous-hydrocarbon systems,effects of surfactant structures on phase and interfacial properties, and structure of the t-butyl alcohol-water system. (DLC)

PHYSICS RESEARCH

ASTROPHYSICS AND COSMOLOGY

STARS

38901 (LA-UR—80-2725) **Core helium flash.** Cole, P.W.; Deupree, R.G. (Los Alamos Scientific Lab., NM (USA); Boston Univ., MA (USA). Dept. of Astronomy). 1980. Contract W-7405-ENG-36. 4p. (CONF-800872—3). NTIS, PC A02/MF A01.

From International astronomical union colloquium 58 on stellar hydrodynamics; Los Alamos, NM, USA (Aug 1980).

The role of convection in the core helium flash is simulated by two-dimensional eddies interacting with the thermonuclear

runaway. These eddies are followed by the explicit solution of the 2D conservation laws with a 2D finite difference hydrodynamics code. Thus, no phenomenological theory of convection such as the local mixing length theory is required. The core helium flash is violent, producing a deflagration wave. This differs from the detonation wave (and subsequent disruption of the entire star) produced in previous spherically symmetric violent core helium flashes as the second dimension provides a degree of relief which allows the expansion wave to decouple itself from the burning front. Our results predict that a considerable amount of helium in the core will be burned before the horizontal branch is reached and that some envelope mass loss is likely.

38902 (LA-UR—80-2756) **Effect of stellar structure on supernova remnant evolution.** Jones, E.M.; Smith, B.W.; Straka, W.C. (Los Alamos Scientific Lab., NM (USA); Jackson State Univ., MS (USA)). 1980. Contract W-7405-ENG-36. 7p. (CONF-800872—4). NTIS, PC A02/MF A01.

From International astronomical union colloquium 58 on stellar hydrodynamics; Los Alamos, NM, USA (Aug 1980).

One-dimensional hydrodynamic calculations have been done of 1E51 erg explosions in 15M/sub sun/ stars. A steep external density gradient to the pre-supernova model of Weaver et al was appended with the results: (1) the outer shock wave decelerates throughout the pre-Sedov phase, (2) the expanding stellar envelope and the shocked interstellar material are Rayleigh-Taylor stable until the Sedov phase, and (3) steep internal density gradients are R-T unstable during the early expansion and may be the source of high velocity knots seen in Cas A.

SOLAR PHENOMENA

38903 **Observations of large fluxes of He^+ in the solar wind following an interplanetary shock.** Gosling, J.T.; Asbridge, J.R.; Bame, S.J.; Feldman, W.C.; Zwickl, R.D. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). *J. Geophys. Res.;* **85**: No. A7, 3431-3434(1 Jul 1980).

Los Alamos Scientific Laboratory instrumentation on Imp 7 has detected large fluxes of He^+ within that volume of solar wind plasma believed to be the solar ejecta driving the interplanetary shock wave disturbance of July 29, 1977. The very high he^+/He^{++} abundance ratio of 0.3 measured during this event suggests that this was solar prominence material only partially ionized by its passage through the corona.

GALAXIES

38904 (LA-UR—80-2551) **Estimates of expansion time scales.** Jones, E.M. (Los Alamos Scientific Lab., NM (USA)). 1979. Contract W-7405-ENG-36. 18p. (CONF-7911112—1). NTIS, PC A02/MF A01.

From Symposium on the implications of our failure to detect extraterrestrials in the solar system; College Park, MD, USA (Nov 1979).

Monte Carlo simulations of the expansion of a spacefaring civilization show that descendants of that civilization should be found near virtually every useful star in the Galaxy in a time much less than the current age of the Galaxy. Only extreme assumptions about local population growth rates, emigration rates, or ship ranges can slow or halt an expansion. The apparent absence of extraterrestrials from the solar system suggests that no such civilization has arisen in the Galaxy. 1 figure.

38905 (LA-UR—80-2787) **Fragmentation in rotating isothermal protostellar clouds.** Bodenheimer, P.; Tohline, J.E.; Black, D.C. (California Univ., Santa Cruz (USA). Lick Observatory; Los Alamos Scientific Lab., NM (USA); National Aeronautics and Space Administration, Moffett Field, CA (USA). Ames Research Center). 1980. Contract W-7405-ENG-36. 7p. (CONF-800872—5). NTIS, PC A02/MF A01.

From International astronomical union colloquium 58 on stellar hydrodynamics; Los Alamos, NM, USA (Aug 1980).

Results of an extensive set of 3-D hydrodynamic calculations that have been performed to investigate the susceptibility of rotating clouds to gravitational fragmentation are presented. (GHT)

PLANETARY PHENOMENA

REFER ALSO TO CITATION(S) 38894

ATMOSPHERIC PHYSICS

AURORAL AND IONOSPHERIC PHENOMENA

38906 (CONF-800491—, pp 493-495) **Plasmaspheric and magnetospheric effects of POTV and COTV effluents.** Chiu, Y.T. (Space Sciences Lab., Los Angeles, CA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

This briefing deals with the current (FY80) progress in quantitative assessment of rocket engine exhaust effects of the Satellite Power System (SPS) in the magnetosphere and ionosphere. We shall consider argon ion engine effects for the cargo orbit transfer vehicles (COTV) and the LO_2/LH_2 chemical engine effects of the personnel orbit transfer vehicle (POTV). Both of these vehicles will make a number of trips between low earth orbit (LEO) and geosynchronous orbit (GEO) during the construction phase of each SPS. The long-term accumulative effects (if any) are presently unknown, and they depend on factors such as the number and scheduling of SPS spacecraft construction. The quantitative assessment for FY 1980 is limited to the short term fate of the orbit transfer vehicle exhaust for the construction of a single SPS.

MAGNETOSPHERIC PHENOMENA

38907 (CONF-800491—, pp 496-500) **Disposition of SPS electric thruster exhaust.** Holze, D.H.; Liemohn, H.B. (Boeing Aerospace Co., Seattle, WA). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

The transit of large Space Power System vehicles from low earth orbit to geosynchronous altitude requires electric thruster propulsion that will deposit great quantities of ions into the magnetosphere. Interactions between this foreign material and the natural environment needs study in order to assess possible modifications of communication paths, auroral illumination levels, and radiation dosage to spacecraft. Methodology has been developed for determining the temporal and spatial distribution of the exhaust ions (probably A^+) from the Orbit Transfer Vehicles (OTVs). The analysis takes account of large angles between the thrust vector and the OTV velocity (nearly orthogonal) which are required to reach the equatorial plane. Consequently, the dense plume of thruster ions is seldom normal to the earth's field, as frequently suggested. After the initial expansion, individual ions follow (Van Allen type) trapped trajectories in the geomagnetic field. The principal loss mechanism is charge exchange with natural oxygen and hydrogen. Preliminary quantitative estimates indicate only a fraction of the exhaust ions reenter the atmosphere; most escape.

38908 (CONF-800491—, pp 501-504) **Effects of argon ion injections in the plasmasphere.** Curtis, S.A.; Grebowsky, J.M. (Goddard Space Flight Center, Greenbelt, MD). Jul 1980.

From Solar power satellite program review; Lincoln, NB, USA (22 Apr 1980).

In lifting massive space power system payloads from low earth orbit to geosynchronous earth orbit, Cargo Orbit Transfer Vehicles (COTV) using ion propulsion will inject energetic beams of argon ions into the plasmasphere. The characteristic velocities of the argon ions and their effects on the plasmasphere are discussed. (WHK)

ATOMIC, MOLECULAR, AND CHEMICAL PHYSICS

38909 **Critical test of vibrational dephasing theories in solids using spontaneous Raman scattering in isotopically mixed crystals.** Marks, S.; Cornelius, P.A.; Harris, C.B. (Department of Chemistry, University of California). *J. Chem. Phys.;* **73**: No. 7, 3069-3081(1 Oct 1980).

A series of experiments have been conducted in order to evaluate the relative importance of several recent theories of vibrational dephasing in solids. The theories are discussed briefly, and are used to interpret the temperature dependence of the C—H and C—D stretch bands in the spontaneous Raman spectra of h_{14}- and d_{14}-1,2,4,5-tetramethyl benzene (durene). The infrared spectra of these same molecules are also reported in the region of the combination bands involving C—H (or C—D) stretches and low-frequency modes. The results support the applicability of the model of Harris et al., [C. B. Harris, R. M. Shelby and P. A. Cornelius, Phys. Rev. Lett. 38, 1415 (1977); Chem Phys. Lett. 57, 8 (1978); R. M. Shelby, C. B. Harris, and P. A. Cornelius, J. Chem. Phys. 70, 34 (1979)], based on energy exchange in anharmonically coupled low-frequency modes. This theory is then used, in connection with Raman spectra obtained in isotopically mixed samples of durene, to elucidate the vibrational dynamics underlying the dephasing. It is found that the results are consistent with the hypothesis that some low-frequency modes in

this molecule are significantly delocalized or "excitonic" in character, and that this delocalization may be studied by means of Raman spectroscopy on the low-frequency modes themselves, as well as by exchange analysis of the coupled high-frequency modes. These conclusions represent a generalization and extension of the previously published exchange model [R. M. Shelby, C. B. Harris, and P. A. Cornelius, J. Chem Phys. 70, 34 (1979)].

BEAMS AND THEIR REACTIONS

38910 (DOE/ER/03158—73) **Range profiles of low energy (100 to 1500 eV) implanted ^{3}He and ^{4}He in tungsten. II. Analysis and discussion. Materials Science Center Report No. 4108.** Amano, J.; Wagner, A.; Seidman, D.N. (Cornell Univ., Ithaca, NY (USA). Dept. of Materials Science and Engineering). Aug 1980. Contract AS02-76ER03158. 38p. NTIS, PC A03/MF A01.

The identifiable sources of possible systematic error in the measurement of the mean range (x bar) and the straggling (Δx) of the ^{3}He and ^{4}He range profiles, reported on in a previous paper were modeled mathematically and the resulting expressions numerically evaluated. The evaluations showed that these possible sources of systematic error were not of significant magnitude to affect the range parameters x bar and Δx. The role of the transfer of energy, either indirectly or directly, from the incoming beam of He ions to those He atoms that had already been implanted was also considered as a possible source of systematic error. It was shown that there was a possibility of radiation-induced diffusion or the simple collisional displacement of He atoms at an implantation energy of 100 eV and a dose of 4×10^{15} cm^{-2}. It was also demonstrated that for the sample sizes employed in the experimental work (Part I) the integral profiles were characterized with a reasonable degree of statistical significance. The experimental results presented in Part I were compared with the calculated results of Biersack's and Haggmark's TRIM simulation program. There was qualitative agreement between the experimental and calculated values of the range parameters but not quantitative. In general, the experimental values of the dimensionless range parameters were greater then the calculated values. The possible sources of this discrepancy were attributed to: the use of the Moliere interatomic potential in the TRIM program; and possible low-energy channeling effects along the [110] direction of W. Simple expressions were given for the experimental range-energy data and the effective stopping powers of both ^{3}He and ^{4}He in W in the energy range 100 to 1500 eV.

38911 (LBL—11434) **Photoelectron photoion molecular beam spectroscopy.** Trevor, D.J. (California Univ., Berkeley (USA)). Dec 1980. Contract W-7405-ENG-48. 155p. NTIS, PC A08/MF A01.

Thesis.

The use of supersonic molecular beams in photoionization mass spectroscopy and photoelectron spectroscopy to assist in the understanding of photoexcitation in the vacuum ultraviolet is described. Rotational relaxation and condensation due to supersonic expansion were shown to offer new possibilities for molecular photoionization studies. Molecular beam photoionization mass spectroscopy has been extended above 21 eV photon energy by the use of Stanford Synchrotron Radiation Laboratory (SSRL) facilities. Design considerations are discussed that have advanced the state-of-the-art in high resolution vuv photoelectron spectroscopy. To extend gas-phase studies to 160 eV photon energy, a windowless vuv-xuv beam line design is proposed.

38912 **Intense annular relativistic electron beam generation in foilless diodes.** Jones, M.E.; Thode, L.E. (Intense Particle Beam Theory Group, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87545). W-7405-ENG.36. *J. Appl. Phys.;* **51**: No. 10, 5212-5214(Oct 1980).

The generation of intense annular electron beams in cylindrical foilless diodes is analyzed. A beam equilibrium model is used to determine the diode current. At low voltage the current is very nearly that of the space-charge limited beam. However, at higher voltages the current can be substantially less than the space-charge limit. The analysis is compared to detailed particle-in-cell simulations.

38913 **Scattering of 5- to 30-keV hydrogen from surfaces.** Harriss, J.E.; Young, R.; Thomas, E.W. (School of Physics, Georgia Institute of Technology, Atlanta, Georgia 30332). *J. Appl. Phys.;* **51**: No. 10, 5344-5351(Oct 1980).

Studies have been performed of the energy distribution exhibited by recoil H^+ and H^- resulting from the impact of 7.5- to 15-keV H^+ on targets of Be, C, Cu, Nb, Au, and stainless steel. The scattering geometry involves near grazing incidence and emergence with a scattering angle of 30.4°. Peak flux occurs at higher recoil energies than in previously published studies with large-angle (135°) scattering. The energy spectrum has been shown to be in excellent agreement with the TRIM computer simulation for one case. The charge state distribution of recoils appears to be governed by charge transfer and ionization events in biparticle collisions occurring as the recoil emerges through the surface monolayer. In the study of recoil H^+ fragments produced by H^+_2 impact there is evidence that the collision processes experienced by the fragments are in some way correlated. Recoil spectra due to D^+ impact are not the same as for equal energy nor equal velocity H^+ impact. The difference is explained and a simple scaling procedure suggested to relate energy spectra for the two isotopes.

38914 **Impact-parameter dependence of K-shell vacancy production in Nb-Mo collisions.** Schuch, R.; Nolte, G. (Heidelberg Univ. (Germany, F.R.). Physikalisches Inst.); Johnson, B.M.; Jones, K.W. (Brookhaven National Lab., Upton, NY (USA)). *Z. Phys., A;* **293**: No. 1, 91-92(1979).

The impact parameter (b) dependence of K-shell vacancy production probability for 1,5 MeV/u Nb on Mo collisions has been measured. Consistent with previous experiments on other high Z collison systems, the shape of the b-dependence shows significant deviations form the two-state $2p\pi$-2p sigma rotational coupling model.

ATOMIC AND MOLECULAR PROPERTIES

38915 (ANL—79-65(Pt.1), pp 7-24) **High-resolution photoabsorption and photoionization spectra of HD and D_2.** Dehmer, P.M. (Univ. of Illinois, Urbana); Dardi, P.S.; Chupka, W.A. 1979.

In Radiological and Environmental Research Division annual report, October 1978-September 1979. Part I. Fundamental molecular physics and chemistry.

Relative photoabsorption and photoionization cross sections for D_2 and HD are reported in the wavelength region between approximately 805 A and 735 A. Many members of the np $\sigma^1\Sigma$/sub u/$^+$ and npπ^1Pi/sub u/ Rydberg series for low n and low v were identified from previous assignments. An attempt was made to extend the assignments to higher vibrational quantum numbers for n=3-6, using previously reported spectroscopic constants. This attempt was only moderately successful because of the overlap of vibrational bands at higher v. The increasing complexity of the spectra at high v and at high n requires a more sophisticated analysis such as would be provided by multichannel quantum defect theory (MQDT). Ionization efficiencies were calculated for all identified states. The ionization efficiency was 1 for states which can autoionize by $\Delta v = 1$, i.e., the final state of the ion has a vibrational quantum number 1 less than the autoionizing state. In general, the ionization efficiency drops rapidly with $\Delta v > 1$. The 3pπ^1Pi/sub u/ state, which can autoionize only with a $\Delta v \geq 7$, has essentially an ionization efficiency of zero, so decay must proceed by predissociation or molecular fluorescence.

38916 (ANL—79-65(Pt.1), pp 30-39) **Oscillator-strength distributions for oxygen, carbon dioxide, water, methyl chloride, and carbon tetrachloride.** Person, J.C.; Nicole, P.P. 1979.

In Radiological and Environmental Research Division annual report, October 1978-September 1979. Part I. Fundamental molecular physics and chemistry.

New measurements of photoabsorption give oscillator-strength values for the following gases and energy regions: O_2, 7.34 to 11.79 eV; CO_2, 7.34 to 11.77 eV; H_2O, 6.62 to 11.80 eV; CH_3CL, 6.14 to 11.25 eV; and CCl_4, 6.14 to 11.49 eV. Comparisons are made with some values from the literature.

38917 **Optical techniques for actinide research.** Veal, B.W. (Argonne National Lab., IL (USA)). *J. Phys. (Paris), Colloq.;* No. 4, C4.163-C4.170(1979).

From 3. International conference on electronic structure of the actinides; Grenoble, France (30 Aug - 1 Sep 1978).

In recent years, substantial gains have been made in the development of spectroscopic techniques for electronic properties studies. These techniques have seen relatively small, but growing, application in the field of actinide research. Photoemision spectroscopies, reflectivity and absorption studies, and X-ray techniques will be discussed and illustrative examples of studies on actinide materials will be presented.

38918 **Fluorescence monitor method for measuring effective absorption coefficients of molecular rovibronic transitions using tunable dye laser excitation: The case of absorber linewidth narrower than the laser linewidth applied to H_2CO.** Fairchild, P.W.; Garland, N.L.; Howard, W.E. III; Lee, E.K.C. (Department of Chemistry, University of California, Irvine, California 92717). *J. Chem. Phys.;* **73**: No. 7, 3046-3052(1 Oct 1980).

A technique for measuring "effective" absorption coefficients is described. It circumvents deviations from Beer's law caused when the excitation source bandwidth is larger than the absorber bandwidth. The technique employs a fluorescence cell placed after an absorption cell to selectively monitor absorption in the center region of the source line. Model calculations relating the fluorescence intensity to source and absorber line shapes indicate that this method should yield linear Beer's law plots for moderate values of k_0Nl and α, where α is the ratio of the source bandwidth to the absorber bandwidth. This technique has been applied to a number of single

rotational levels in the 4^1_0 transition of the H_2CO A $^1A_2$←X $^1A_1$ system using pulsed, tunable dye laser excitation. The effective absorption coefficients determined experimentally have been compared to the theoretically calculated absorption coefficients.

38919 Prototype aluminum—carbon single, double, and triple bonds: Al—CH_3, Al=CH_2, and AlequivalentCH. Fox, D.J.; Ray, D.; Rubesin, P.C.; Schaefer, H.F. III. (Department of Chemistry and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *J. Chem. Phys.;* **73**: No. 7, 3246-3254(1 Oct 1980).

Nonempirical quantum mechanical methods have been used to investigate the $AlCH_3$, $AlCH_2$, and AlCH molecules, which may be considered to represent the simplest aluminum—carbon single, double, and triple bonds. Equilibrium geometries and vibrational frequencies were determined at the self-consistent-field level of theory using a double zeta basis set: Al(11s7p/6s4p), C(9s5p/4s2p), H(4s/2s). The $^1A_1$ ground state of $AlCH_3$ has a reasonably conventional Al—C single bond of length 2.013 A, compared to 1.96 A in the known molecule $Al(CH_3)_3$. The CH equilibrium distance is 1.093 A and the Al—C—H angle 111.9 °. The structures of three electronic states each of $AlCH_2$ and AlCH were similarly predicted. The interesting result is that the ground state of $AlCH_2$ does not contain an Al—C double bond, and the ground state of AlCH is not characterized by an AlequivalentC bond. The multiply bonded electronic states do exist but they lie 21 kcal ($AlCH_2$) and 86 kcal (AlCH) above the respective ground states. The dissociation energies of the three ground electronic states are predicted to be 68 kcal ($AlCH_3$), 77 kcal ($AlCH_2$), and 88 kcal (AlCH). Vibrational frequencies are also predicted for the three molecules, and their electronic structures are discussed with reference to Mulliken populations and dipole moments.

38920 Possible role for triplet H_2CN^+ isomers in the formation of HCN and HNC in interstellar clouds. Allen, T.L.; Goddard, J.D.; Schaefer, H.F. III. (Department of Chemistry, University of California, Davis, California 95616). *J. Chem. Phys.;* **73**: No. 7, 3255-3263(1 Oct 1980).

The structures and energies of the lowest triplet states of four isomers of H_2CN^+ have been determined by self-consistent field and configuration interaction calculations. When both hydrogen atoms are attached to the nitrogen atom, H_2NC^+, the molecule has its lowest triplet state energy, which is 97.2 kcal mol^{-1} above the energy of the linear singlet ground state. The structure has C/sub 2v/ symmetry, with an HCH bond angle of 116.8°, and bond lengths of 1.009 A (H—N) and 1.268 A (N—C). Other isomers investigated include the H_2CN^+ isomer at 104.7, the cis-$HCNH^+$ isomer at 105.3, and the trans-$HCNH^+$ isomer at 113.6 kcal mol^{-1}. The H_2CN^+ isomer has an unusual "carbonium nitrene" structure, with a C—N bond length of 1.398 A. It is suggested that the triplet H_2NC^+ isomer may play a role in determining the relative yields of HCN and HNC from the reaction of C^+ and NH_3. Specifically, a triplet path is postulated in which C^+ and NH_3 yield the triplet H_2NC^+ isomer, which then yields the singlet H_2NC^+ isomer by phosphorescent emission. Because this emission removes a large amount of energy, the singlet H_2NC^+ isomer may have insufficient energy to isomerize to the linear singlet ground state. Subsequent dissociative recombination would yield the HNC isomer exclusively.

38921 C—H hyperconjugation in alkyl benzene cations as revealed by position-dependent isotope effects on nonradiative decay rates of electron donor—acceptor complexes. Okajima, S.; Lim, B.T.; Lim, E.C. (Department of Chemistry, Wayne State University, Detroit, Michigan 48202). *J. Chem. Phys.;* **73**: No. 7, 3512-3514(1 Oct 1980).

A major methyl deuteration effect on the nonradiative decay rate of electron donor-acceptor complexes in reported. This effect indicates strongly the importance of c-h hyperconjugation in alkyl lethzene cations.(AIP)

38922 Rational fraction representation of diatomic vibrational potentials. Application of H_2^+ ground state. Beckel, C.L.; Findley, P.R. (Department of Physics and Astronomy, University of New Mexico, Albuquerque, New Mexico 87131). *J. Chem. Phys.;* **73**: No. 7, 3517-3518(1 Oct 1980).

Jordan, et al.[10], have proposed use of Pade approximants for representing V(R); an extension of this procedure to te use of rational fractions [N/M] is proposed in the present paper, and applied to the ground state of H_2^+.(AIP)

38923 Atomic multiplet structures obtained from Hartree-Fock, statistical exchange and local spin density approximations. Wood, J.H. (Los Alamos Scientific Lab., NM (USA)). *J. Phys., B (London);* **13**: No. 1, 1-14(14 Jan 1980).

Numerical calculations by the Hartee-Fock, the statistical exchange and the local spin density approximations of the multiplet structures of eight light atoms and their ions are compared with one another and with experiment. It is concluded that the statistical approximation agrees well with Hartree-Fock, the local spin density approximation agrees well with experiment, and the Xα generalisation of the statistical exchange approximation does not include correlation effects. A peculiarity of approximation exchange schemes which depend on the one-electron density (instead of the one-electron orbitals) is pointed out.

38924 Phase transitions in highly-correlated f-electron systems with fluctuating valence. Sinha, S.K.; Fedro, A.J. (Argonne National Lab., IL (USA); Northern Illinois Univ., Dekalb (USA)). *J. Phys. (Paris), Colloq.;* No. 4, C4.214-C4.217(1979).

From 3. International conference on electronic structure of the actinides; Grenoble, France (30 Aug - 1 Sep 1978).

A formalism is presented for treating electrons in highly-correlated spin-orbit coupled multiplet levels in f-shells, which are also hybridized with valence or conduction states. This is achieved by introducing operators which cause transitions between the configurations, but project out all other configurations. The Zwanzig-Mori projection operator technique is exploited to derive results for the electron Green's functions, which are then solved self-consistently. The lowest order self-consistent solutions bear a certain resemblance to unrestricted Hartree-Fock theory. Higher-order terms exhibit Kondo-like singularities under certain conditions. It is shown that several phases, both configurational and magnetic, are possible depending on the relative values of the conduction electron bandwidth, the hybridization energy and the values of the Coulomb and exchange integrals.

38925 Systematic of hyperfine interactions in actinyl compounds. Dunlap, B.D.; Kalvius, G.M. (Argonne National Lab., IL (USA)). *J. Phys. (Paris), Colloq.;* No. 4, C4.192-C4.193(1979).

From 3. International conference on electronic structure of the actinides; Grenoble, France (30 Aug - 1 Sep 1978).

Hyperfine interactions in several actinyl complexes are presented. The electric quadrupole and magnetic hyperfine interaction constants are calculated within a simple model whereby non-bonding electrons, perturbed by an axial crystal field, are added to a uranyl core. This approach provides reasonable agreement for all cases except the quadrupole interaction in $5f^2$ systems, where the measured values are about three times smaller than those calculated.

COLLISION PHENOMENA

REFER ALSO TO CITATION(S) 38937

38926 (ANL—79-65(Pt.1)) Radiological and Environmental Research Division annual report, October 1978-September 1979. Part I. Fundamental molecular physics and chemistry. (Argonne National Lab., IL (USA)). 1979. Contract W-31-109-ENG-38. 183p. NTIS, PC A09/MF A01.

Research on the chemical physics of atoms and molecules, especially their interaction with external agents such as photons and electrons is reported. Abstracts of seven individual items from the report were prepared separately for the data base. (GHT)

38927 (ANL—79-65(Pt.1), pp 83-89) Closure formula for vibrational excitation in electron-polar molecule scattering. Siegel, J.; Dehmer, J.L.; Dill, D. 1979.

In Radiological and Environmental Research Division annual report, October 1978-September 1979. Part I. Fundamental molecular physics and chemistry.

Application of the closure formula to electron-dipolar molecule scattering is straightforward if the nuclei are frozen at R = R/ sub e/. Here it is applied to vibrationally inelastic scattering, focussing particularly on the R dependence of exact and Born approximation T matrix elements. This R-dependence must be the same for the two levels of approximation if the closure formula is to be applied.

38928 (ANL—79-65(Pt.1), pp 90-94) Vibrational excitation in electron-DCl scattering. Siegel, J.; Dehmer, J.L.; Dill, D. 1979.

In Radiological and Environmental Research Division annual report, October 1978-September 1979. Part I. Fundamental molecular physics and chemistry.

A preliminary report is given of the results of fixed-nuclei and adiabatic calculations of the e-HCl and e-DCl electron-molecule scattering systems. The calculations are performed in the rotational and vibrational adiabatic approximation, and the use of DCl rather than HCl allows calculation to substantially lower energy. (GHT)

38929 (ANL—79-65(Pt.1), pp 97-99) Electron scattering from CsCl. Siegel, J.; Dehmer, J.L.; Dill, D. 1979.

In Radiological and Environmental Research Division annual report, October 1978-September 1979. Part I. Fundamental molecular physics and chemistry.

A spectral study of electron-molecule scattering on cesium chloride is reported. A hybrid method of calculating the core potential is presented. At 5 and 20 eV, differential cross sections are compared between calculated and experimental with good agreement. (GHT)

38930 (ANL—79-65(Pt.1), pp 100-102) **Electron scattering from HCN.** Siegel, J.; Dehmer, J.L.; Dill, D. 1979.

In Radiological and Environmental Research Division annual report, October 1978-September 1979. Part I. Fundamental molecular physics and chemistry.

The hybrid model of electron-polar molecule scattering has been used to calculate scattering of electrons from first-row diatomic molecules (LiF); large, strongly polar systems (CsCl); and systems showing pronounced vibrational effects (HCl, DCl). Initial results are reported for the extension to HCN, the first calculation on a polyatomic molecule and the first such calculation on a strongly polar system expected to display a characteristic shape resonance within a few eV of threshold. (GHT)

38931 (ANL—79-65(Pt.1), pp 150-155) **Method for implementing electron collision cross section calculations by use of experimental data.** Dillon, M.A. 1979.

In Radiological and Environmental Research Division annual report, October 1978-September 1979. Part I. Fundamental molecular physics and chemistry.

A method is proposed in which data collected in the Born region can be used to implement the application of formulations more complicated than the Born approximation. The technique is applied to the electron-impact excitation of the 2^1S and 3^1S levels of helium in the Coulomb projected Born approximation.

38932 (COO—4694-3) **Low energy ion-molecule reaction dynamics and chemiionization kinetics. Progress report, February 1, 1980-January 31, 1981.** Farrar, J.M. (Rochester Univ., NY (USA)). 1981. Contract AS02-78ER04694. 14p. NTIS, PC A02/MF A01.

Reactive scattering studies were completed over a wide energy range on the systems $H_2^+ + Ar$, $H_2^+ + H_2O$, $H_2^+ + D_2O$, and $H_2^+ + Ne$. Work was begun on the proton transfer system $HCO^+ + H_2O \rightarrow H_3O^+ + CO$.

38933 (ORNL—5665, pp 159-169) **Theoretical chemistry.** Jul 1980.

In Chemistry Division annual progress report, February 29, 1980.

Progress is reported on: atomic scattering theory (energy of O^{7+} moving in Au <100> channel anomalous enhancement of 180° backscattering), statistical mechanics (particle distribution functions, lattice gases), and theoretical chemical kinetics of bimolecular and unimolecular processes (vibrational energy transfer in polyatomic molecules, infrared multiphoton dissociation, bound states, scattering theory in quasiperiodic and stochastic regime). 9 figures, 1 table. (DLC)

38934 **Electron detachment from Cl^- in collisions with H_2 and D_2 (5< or ≃E/sub rel/< or ≃50 eV).** Cheung, J.T.; Datz, S. (Chemistry Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *J. Chem. Phys.;* **73**: No. 7, 3159-3165(1 Oct 1980).

Energy losses accompanying the detachment of an electron from Cl^- in collision with H_2 and D_2 have been measured using a time-of-flight technique. Four different energy loss channels are identified and their excitation functions mapped: (1) $\Delta E \simeq 4$ eV corresponding to "simple detachment" (E.A. $Cl^- = 3.6$ eV); (2) $\Delta E \simeq 8$ eV corresponding to dissociative attachment; (3) ΔE ranging from 11 eV at E/sub rel/≃15 eV to 14 eV at E/sub rel/≃50 eV associated with detachment to the $^2\Sigma^+$/sub g/ state of H^-_2; (4) "spectator" backscattering from a single hydrogen atom.

38935 **Progress in the application of classical S-matrix theory to inelastic collision processes.** McCurdy, C.W.; Miller, W.H. (Department of Chemistry, and Materials and Molecular Research Division of Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *J. Chem. Phys.;* **73**: No. 7, 3191-3197(1 Oct 1980).

Methods are described which effectively solve two of the technical difficulties associated with applying classical S-matrix theory to inelastic/reactive scattering. Specifically, it is shown that rather standard numerical methods can be used to solve the "root search" problem (i.e., the nonlinear boundary value problem necessary to impose semiclassical quantum conditions at the beginning and the end of the classical trajectories) and also how complex classical trajectories, which are necessary to describe classically forbidden (i.e., tunneling) processes, can be computed in a numerically stable way. Application is made to vibrational relaxation of H_2 by collision with He (within the helicity conserving approximation). The only remaining problem with regard to applying classical S-matrix theory to complex collision processes has to do with the availability of multidimensional uniform asymptotic formulas for interpolating the "primitive" semiclassical expressions between their various regions of validity.

ATOMIC AND MOLECULAR THEORY

38936 (DOE/ER/01674—172) **Basic studies of atomic dynamics. Progress report, October 1, 1979-September 30, 1980.** Fano, U. (Chicago Univ., IL (USA)). 15 Sep 1980. Contract AS02-76ER01674. 12p. NTIS, PC A02/MF A01.

Potential ridges, now identified as the locus of breakdown of approximate separability of coordinates, require a special physico-mathematical treatment the initial phase of which has now been completed. The role of a potential ridge in separating the pair of exit channels of lower-energy two-electron excitations is circumscribed and hence accessible to numerical calculations; it has thus been studied in some detail for earth-alkaline-like configurations and for He^-. Quantum defect theory approaches have been extended to molecular predissociation and to the study of Stark effect wavefunctions; these extensions have now proved so far from the origins of the approach that a new name and description would be more appropriate.

38937 **Applicability of self-consistent field techniques based on the complex coordinate method to metastable electronic states.** McCurdy, C.W.; Rescigno, T.N.; Davidson, E.R.; Lauderdale, J.G. (Chemistry Department, Ohio State University, Columbus, Ohio 43210). *J. Chem. Phys.;* **73**: No. 7, 3268-3273(1 Oct 1980).

Hartree—Fock theory is applied to resonance states of an atomic Hamiltonian under the complex coordinate transformation. It is concluded that for shape resonances restricted Hartree—Fock theory provides a useful and practical approach to the problem of computing the complex resonance energy. Numerical results are presented for the low-energy ^2P shape resonance in e—Be scattering. With properly chosen basis functions the resonance energy obtained in these calculations is practically independent of the phase of the complex scaling parameter for a wide range of values. Application of this technique to molecular resonances is discussed. The widths of Feshbach resonances cannot be obtained from the theory in its present form, but it is suggested that a complex coordinate form of multiconfiguration self-consistent field theory may be appropriate for that case.

FLUID PHYSICS

GENERAL FLUID DYNAMICS

38938 (LA—8355) **SOLA-VOF: a solution algorithm for transient fluid flow with multiple free boundaries.** Nichols, B.D.; Hirt, C.W.; Hotchkiss, R.S. (Los Alamos Scientific Lab., NM (USA)). Aug 1980. Contract W-7405-ENG-36. 123p. NTIS, PC A06/MF A01.

In this report a simple, but powerful, computer program is presented for the solution of two-dimensional transient fluid flow with free boundaries. The SOLA-VOF program, which is based on the concept of a fractional volume of fluid (VOF), is more flexible and efficient than other methods for treating arbitrary free boundaries. SOLA-VOF has a variety of user options that provide capabilities for a wide range of applications. Its basic mode of operation is for single fluid calculations having multiple free surfaces. However, SOLA-VOF can also be used for calculations involving two fluids separated by a sharp interface. In either case, the fluids may be treated as incompressible or as having limited compressibility. Surface tension forces with wall adhesion are permitted in both cases. Internal obstacles may be defined by blocking out any desired combination of cells in the mesh, which is composed of rectangular cells of variable size. SOLA-VOF is an easy-to-use program. Its logical parts are isolated in separate subroutines, and numerous special features have been included to simplify its operation, such as an automatic time-step control, a flexible mesh generator, extensive output capabilities, a variety of optional boundary conditions, and instructive internal documentation.

38939 (ORNL/TM—7140) **Analytical model for a vertical buoyant jet.** Lee, D.W. (Oak Ridge National Lab., TN (USA)). Oct 1980. Contract W-7405-ENG-26. 52p. NTIS, PC A04/MF A01.

An analytical model for a round and two-dimensional turbulent buoyant jet which is discharged vertically into a stagnant ambient is developed. The buoyant jet is considered to have three separate zone models which are matched to form a complete solution. The velocity field is determined for the entire jet and plume regions by the use of an eddy viscosity which varies along the axis of the jet. The centerline decay of buoyancy is determined throughout and the results are compared to existing numerical codes. The model is applied to the disposal of carbon dioxide enriched seawater. The results can be used to provide design information for minimizing or maximizing the dilution of a discharge by the receiving environment.

38940 **Noncanonical Hamiltonian density formulation of hydrodynamics and ideal magnetohydrodynamics.** Morrison, P.J.; Greene, J.M. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). DE-AC02-76-CH03073. *Phys. Rev. Lett.;* **45**: No. 10, 790-794(8 Sep 1980).

A new Hamiltonian density formulation of a perfect fluid with or without a magnetic field is presented. Contrary to previous

work the dynamical variables are the physical variables, rho, v, B, and s, which form a noncanonical set. A Poisson bracket which satisfies the Jacobi identity is defined. This formulation is transformed to a Hamiltonian system where the dynamical variables are the spatial Fourier coefficients of the fluid variables.

PROPERTIES AND STRUCTURE OF FLUIDS

38941 Hydrophobic solvation of nonspherical solutes. Pratt, L.R.; Chandler, D. (Department of Chemistry, University of California, Berkeley, California 94720). *J. Chem. Phys.;* **73**: No. 7, 3430-3433(1 Oct 1980).

The theory of hydrophobic effects presented by Pratt and Chandler is generalized to include nonpolar solutes which are distinctly aspherical. The theory is used to study the solvation of simple aspherical hydrocarbon solutes in liquid water. The radial solvation of each component of diatomiclike solutes is studied as a function of their separation, or bond length. From these results it is found that when the bond length is large enough that one water molecule can fit between the apolar pair, the radial solvation of each is the same as that when the bond length approaches infinity. The solvation of the various sites of the homologous series methane, ethane, propane, and n-butane is also studied, and effects of the geometrical structure of the solutes on their solvation is discussed.

38942 Effects of solute—solvent attractive forces on hydrophobic correlations. Pratt, L.R.; Chandler, D. (Department of Chemistry, University of California, Berkeley, California 94720). *J. Chem. Phys.;* **73**: No. 7, 3434-3441(1 Oct 1980).

A theory is presented for the effect of slowly varying attractive forces on correlations between nonpolar solutes in dilute aqueous solution. We find that hydrophobic correlations are sensitive to relatively long range slowly varying interactions. Thus, it is possible to make qualitative changes in these correlations by introducing small changes in the attractive forces. Several model calculations are presented to illustrate these facts. The contributions of the Lennard-Jones attractive forces to the computer simulation results of Pangali, Rao, and Berne are calculated. For this case it is found that the potential of mean force between spherical nonpolar solutes is hardly affected by inclusion of attractive forces. However, the osmotic second virial coefficient is dominated by the contributions of the attractive forces. For spherical solutes which provide a reasonable model for the methane molecule, inclusion of attractive forces produces a qualitative change in the methane—methane potential of mean force. The connection between these effects of slowly varying attractive forces and the enthalpic part of Ben-Naim's δA/sup H/I is discussed.

38943 Two-electron-group model and Boltzmann calculations for low-pressure gas discharges. Morgan, W.L.; Vriens, L. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). W-7405-ENG-48. *J. Appl. Phys.;* **51**: No. 10, 5300-5306(Oct 1980).

For Ne, Ar, and Cs-Ar positive column plasmas a comparison is presented between Boltzmann and two-electron-group model (2-EGM) calculations. This 2-EGM is an approximation method to account for deviations from a Maxwellian electron energy distribution in plasma modeling. The comparison makes it possible to obtain in the 2-EGM an accurate normalization function for the high-energy tail of the electron energy distribution. The 2-EGM is found to give electron impact collision and energy transfer rates that agree well with those from the Boltzmann calculation over a wide range of currents and pressures.

MAGNETOHYDRODYNAMICS

REFER ALSO TO CITATION(S) 38940

PARTICLE INTERACTIONS AND PROPERTIES - EXPERIMENTAL

38944 (DOE/ER/03065—45) **Progress report for 1979-1980.** Walker, W.D. (Duke Univ., Durham, NC (USA). Dept. of Physics). 16 Sep 1980. Contract AS05-76ER03065. 21p. NTIS, PC A02/MF A01.

This basically administrative report describes research in the following areas: π-neon interactions at 200 GeV; direct γ and e^+e^- pair production; studies of photon production in 16-GeV/c π^+-p interactions; γ-p interactions at 20 GeV; and computer and hardware development. References are given to published work. An expenditure statement is included. (RWR)

38945 (UCD—34PA191-11) **U.C. Davis high energy particle physics research. Annual progress report, October 22, 1979-September 5, 1980.** Gunion, J.F.; Ko, W.; Lander, R.L.; Michael, W.B.; Pellet, D.E.; Williams, M.C.S.; Yager, P.M. (California Univ., Davis (USA). Dept. of Physics). Sep 1980. Contract AT03-76ER70191. 5p. NTIS, PC A02/MF A01.

During the period covered by this report, the experimental group: (1) fabricated a set of drift chambers for the muon detector part of the PEP-9 apparatus; (2) completed data taking at SLAC in a search for narrow four-quark resonant states and began the analysis of the photos; (3) developed software for PEP-9 off-line analysis and Monte Carlo programs; (4) continued data taking at Fermilab for K^0 production studies; and (5) finished drafting several papers that will conclude our bubble chamber studies of π^-d interactions.

38946 Los Alamos: the future of medium energy physics. *CERN Cour.;* **19**: No. 9, 407-409(Dec 1979).

A 'Workshop on Program Options in Intermediate Energy Physics' was recently held at LAMPF and the topics discussed there are summarized. The purpose of the meeting was to establish priorities for experimental research at intermediate energies.

ELECTROMAGNETIC INTERACTIONS

38947 (COO—1195-455) **Photoproduction of charmed baryons.** Russell, J.J. (Illinois Univ., Urbana (USA). Graduate Coll.). 1980. Contract AC02-76ER01195. 114p. NTIS, PC A06/MF A01.

Thesis.

The results of a search for the photoproduction of charmed baryons in the broad-band neutral beam at Fermi National Accelerator Laboratory are reported. The lowest lying charmed baryon (Λ/sub c/$^+$) is observed through its decay to p-anti K^0. The cross section times branching ratio of $\gamma + C \rightarrow \Lambda$/sub c/$^+ + X$, $\gamma + C \rightarrow p +$ anti K^0 is measured to be σ B = 3 nanobarns/nucleon. The total error on this measurement is estimated to be -20% to +40%. The mass of the Λ/sub c/$^+$ is found to be 2.284 +- 0.001 GeV/c^2, in good agreement with the Mark II result from SPEAR. Upper limits (90% confidence level) are set on σ B for the modes $\Lambda^0\pi$, $\Lambda^0\pi\pi\pi$, $pK\pi$.

38948 (DOE/ER/02232—87) **Diffractive photon dissociation on hydrogen (Fermilab Experiment 612).** Goulianos, K. (Rockefeller Univ., New York (USA)). 1980. Contract AC02-76ER02232. 5p. (CONF-800374—8). NTIS, PC A02/MF A01.

From 15. Rencontre de Moriond; Les Arcs, France (9 Mar 1980).

An experiment to measure the diffractive dissociation of high energy photons on hydrogen, $\gamma P \rightarrow XP$, in the region $0.01 < t < 0.1$ (GeV/c)^2 and for M/sub x/^{2}/s < 0.1, covering the mass range M/sub x/ < 5 GeV for the presently available tagged photon energies at Fermilab (20 to 140 GeV) is described. The inclusive differential cross section will be measured. (GHT)

38949 (SLAC-PUB—2530) **Radiative transitions to an eta/sub c/(2980) candidate state and the observation of hadronic decays of this state.** Bloom, E.D. (Stanford Linear Accelerator Center, CA (USA)). Jun 1980. Contract AC03-76SF00515. 9p. (CONF-8004102—3). NTIS, PC A02/MF A01.

From 6. international conference on experimental meson spectroscopy; Upton, NY, USA (25 Apr 1980).

Preliminary results from the Crystal Ball and Mark II experiments at SPEAR are presented on radiative transitions from psi'(3684) and J/psi(3095) to an eta/sub c/(2980) candidate state. In addition to the inclusive photon signals reported previously by the Crystal Ball, both detectors now see exclusive hadronic final state signals at masses consistent with the states inclusively determined mass of 2981 +- 16 MeV.

38950 (SLAC-PUB—2599) **Two-photon results from SPEAR.** Roussarie, A. (Stanford Linear Accelerator Center, CA (USA)). Sep 1980. Contract AC03-76SF00515. 3p. (CONF-800724—29). NTIS, PC A02/MF A01.

From 20. international conference on high energy physics; Madison, WI, USA (17 Jul 1980).

Results obtained by two experiments at SPEAR on the two-photon production of lepton pairs and resonances are reported. Both experiments find agreement of lepton production with QED expectations, and observe an enhancement of the $\pi\pi$ mass spectrum in the 1250 MeV/c^2 region. The Mark II finds this enhancement not consistent with the decay of the f(1270 MeV/c^2) alone. The $\gamma\gamma$ partial width of the eta' has also been measured by the Mark II.

38951 Hadron production from photon-photon interactions in the CM energy range from 1 to 5 GeV. Berger, C.; Genzel, H.; Grigull, R.; Lackas, W.; Raupach, F. (Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Experimentalphysik 1A und 1. Physikalisches Inst.); Klovning, A.; Lillestoel, E.; Lillethun, E. *Phys. Lett., B;* **89**: No. 1, 120-124(31 Dec 1979).

We present the first data on photon-photon annihilation into hadrons for CM energies > 1 GeV obtained with the detector PLUTO at the e^+e^- storage ring PETRA. Cross sections are extracted using an inelastic $e\gamma$ scattering formalism. The results are compared to expectations from Regge-like models.

38952 Energy scan for narrow states in e^+e^- annihilation at C.M. energies between 29.90 and 31.46 GeV. Brandelik, R.; Braunschweig, W.; Gather, K.; Kadansky, V.; Luebelsmeyer, K.; Maettig, P.; Martyn, H.U.; Peise, G.; Rimkus, J.; Sander, H.G. . WY-76-C-02-0881. *Phys. Lett., B;* **88**: No. 1/2, 199-202(3 Dec 1979).

A fine energy scan has been performed to search for narrow states in e^+e^- annihilation at c.m. energies between 29.90 and 31.46 GeV. No such state has been observed. The 90% confidence upper limit on the leptonic decay width times the hadronic decay branching ratio is GAMMA/sub ee/B/sub h/ < 1.6 keV.

38953 From the psi/J to charmed mesons - three years of e^+e^- research at SPEAR. Goldhaber, G. (California Univ., Berkeley (USA). Dept. of Physics). *Physica, A;* **96**: No. 1-2, 31-59(Apr 1979).

The author discusses the results of e^+e^- research at SPEAR, including the discovery of the psi resonances and several charmed meson resonances.

WEAK INTERACTIONS

38954 (SLAC-PUB—2538) **Selected results from the Mark II at SPEAR.** Scharre, D.L. (Stanford Linear Accelerator Center, CA (USA)). Jun 1980. Contract AC03-76SF00515. 31p. (CONF-800588—2). NTIS, PC A03/MF A01.

From International symposium on high energy e+e- interactions; Nashville, TN, USA (1 May 1980).

Recent results on radiative transitions from the psi(3095), charmed meson decay, and the Cabibbo-suppressed decay tau → K* ν/sub tau/ are reviewed. The results come primarily from the Mark II experiment at SPEAR, but preliminary results from the Crystal Ball experiment on psi radiative transitions are also discussed.

38955 (SLAC-PUB—2542) **K^-p interactions at 11 GeV/c: new results on strange meson systems.** Ratcliff, B.N. (Stanford Linear Accelerator Center, CA (USA)). Jun 1980. Contract AC03-76SF00515. 18p. (CONF-8004102—4). NTIS, PC A02/MF A01.

From 6. international conference on experimental meson spectroscopy; Upton, NY, USA (25 Apr 1980).

The status of our programmatic study of states containing a strange quark is briefly reviewed. An 11 GeV/c K^-p experiment run on the LASS spectrometer at SLAC is discussed and preliminary results presented for several inelastic channels based on approximately one half of the available data sample. In addition, new results utilizing the full statistics of the experiment are presented for the elastic $K^-\pi^+$ channel from the $K^-\pi^+n$ final state. The well established leading K*(890), K*(1435), and K*(1780) resonances are observed, and clear evidence is presented for a new J/sup p/ = 4^+ resonance at ~ 2070 MeV. Preliminary results from an energy independent partial wave analysis of these data are presented which display unambiguous evidence for resonant structure in the non-leading 0^+ and 1^- waves.

38956 Muoproduction of neutral strange hadrons at 225 GeV. Hicks, R.G.; Anderson, H.L.; Booth, N.E.; Francis, W.R.; Gordon, B.A.; Kinnison, W.W.; Kirk, T.B.W.; Loomis, W.A.; Matis, H.S.; Mo, L.W.; Myrianthopoulos, L.C.; Pipkin, F.M.; Proudfoot, J.; Quirk, T.W.; Sessoms, A.L.; Shambroom, W.D.; Skuja, A.; Staton, M.A.; Tao, C.; Williams, W.S.C.; Wilson, R.; Wright, S.C. (High Energy Physics Laboratory and Department of Physics, Harvard University, Cambridge, Massachusetts 02138). EY-76-C-02-3064;E(11-1)-1195. *Phys. Rev. Lett.;* **45**: No. 10, 765-768(8 Sep 1980).

The production of K/sub s/ ^{0}, Λ^0, and Lambda-bar^0 has been measured in deep-inelastic muon scattering at 225 GeV; decays into two charged hadrons were detected. Momentum distributions are compared to the inclusive charged-hadron distributions measured in the same experiment. The range of virtual-photon parameters covered is $0.4<Q^2<50$ GeV^2 and $20<\nu<210$ GeV.

38957 Cross-section measurements for charm production by 209-GeV muons. Clark, A.R.; Johnson, K.J.; Kerth, L.T.; Loken, S.C.; Markiewicz, T.W.; Meyers, P.D.; Smith, W.H.; Strovink, M.; Wenzel, W.A.; Johnson, R.P.; Moore, C.; Mugge, M.; Shafer, R.E.; Gollin, G.D.; Shoemaker, F.C.; Surko, P. (Physics Department and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). W-7405-ENG-48;EY-76-C-02-3072;EY-76-C-02-3000. *Phys. Rev. Lett.;* **45**: No. 9, 682-686(1 Sep 1980).

Interactions of 209-GeV muons in the multimuon spectrometer at Fermilab have yielded 20 072 dimuon final states, with (81 +- 10)% attributed to production of charmed states decaying to muons. The cross section for diffractive charm muoproduction is 6.9/sup +1.9//sub -1.4/ nb. Extrapolated to $Q^2=0$, the effective cross section for 178- (100-) GeV photons is 750^{+180}/sub -/130 (560^{+200}/sub -/120) nb.

38958 Limit on Y muoproduction at 209 GeV. Clark, A.R.; Johnson, K.J.; Kerth, L.T.; Loken, S.C.; Markiewicz, T.W.; Meyers, P.D.; Smith, W.H.; Strovink, M.; Wenzel, W.A.; Johnson, R.P.; Moore, C.; Mugge, M.; Shafer, R.E.; Gollin, G.D.; Shoemaker, F.C.; Surko, P. (Physics Department and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). W-7504-ENG-48;DE-AC02-76ER03072;EY-76-C-02-3000. *Phys. Rev. Lett.;* **45**: No. 9, 686-688(1 Sep 1980).

We present the dimuon mass spectrum from 102 678 three-muon final states produced by muon interactions within a magnetized steel calorimeter. The data place a 90%-confidence-level upper limit on the production Y states by muons: $\sigma(\mu N\rightarrow\mu YX)B(Y\rightarrow\mu^+\mu^-)<22\times10^{-39}$ cm^2, consistent with a photon-gluon-fusion model calculation.

38959 Comparison of jet size in anti νp interactions with that in e^+e^- annihilation. Derrick, M.; Fridman, A.; Gregory, P.; Lopinto, F.; Musgrave, B.; Schlereth, J.; Schreiner, P.; Singer, R. (Argonne National Lab., IL (USA)). *Phys. Lett., B;* **88**: No. 1/2, 177-180(3 Dec 1979).

By use of new anti νp charged-current data from the Fermilab 15 foot hydrogen bubble chamber, some properties of the anti ν-induced hadronic jets are studied. The angular size of the jets is measured and compared with results from e^+e^- annihilation. The jets in the two processes are found to be quite similar in terms of the variables sphericity, thrust, and energy flow.

38960 Search for a charm changing neutral current in antineutrino interactions. Efremenko, V.; Pedotov, A.; Gorichev, P.; Kaftanov, V.; Kliger, G.; Kolganov, V.; Krutchinin, S.; Kubantsev, M.; Makhlyueva, I.; Shekeljan, V. . *Phys. Lett., B;* **88**: No. 1/2, 181-184(3 Dec 1979).

A search for charmed particle production in anti neutrino-nucleon neutral-current interactions is reported. The recognition signature used was positron decay of the charmed particle; however, all single positron events found can be attributed to known sources. Based upon a possible signal of one event, the 90% confidence level upper limit for the rate of neutral-current charmed particle production with subsequent positron decay relative to charged-current interactions above the charm threshold is 1.45×10^{-3}. Assuming a branching ratio of 0.1, we find the corresponding limit for the right handed anti uc coupling is 1.9×10^{-2}.

38961 Neutral current breaks up deuterons. *CERN Cour.;* **19**: No. 8, 365-366(Nov 1979).

The Weinberg-Salam model predicts the decay of the deuteron due to neutral current effects. These predictions are supported by recent results from the Irvine group working at the Savannah River reactor.

STRONG BARYON-INDUCED INTERACTIONS

REFER ALSO TO CITATION(S) 39064

38962 (LBL—9711, pp 43-45) **Tensor and vector analyzing powers in p-d vector elastic scattering at GeV energies.** Sagle, A.L. (Univ. of California, Los Angeles); Carroll, J.B.; Bleszynski, M. Mar 1980.

In Nuclear science. Annual report, July 1, 1978-June 30, 1979.

Polarized deutrons were used to bombard a liquid hydrogen target to measure the analyzing powers P/sub y/, P/sub yy/, and P/sub xx/. Data were taken for equivalent proton energies of 0.4, 0.6, 0.8, and 1.0 GeV. Results are shown for the latter energy. The dependence of the spherical tensor components t_{20} on equivalent proton bombarding energy is shown. 2 figures. (RWR)

38963 Measurement of forward jets produced in high—transverse-momentum hadron-proton collisions. Bromberg, C.; Fox, G.; Gomez, R.; Pine, J.; Rohlf, J.; Stampke, S.; Yung, K.; Erhan, S.; Lorenz, E.; Medinnis, M.; Schlein, P.; Ashford, V.; Haggerty, H.; Juhala, R.; Malamud, E.; Mori, S.; Abrams, R.; Delzenero, R.; Goldberg, H.; Margulies, S.; McLeod, D.; Solomon, J.; Stanek, R.; Dzierba, A.; Kropac, W. (California Institute of Technology, Pasadena, California 91125). DE-AC-030-79ER0068;E(11-1)-2009. *Phys. Rev. Lett.;* **45**: No. 10, 769-772(8 Sep 1980).

A measurement of charged-particle production is reported for the forward region in events triggered by high—transverse-momentum (p/sub perpendicular/) jets and single particles. The momentum distributions of forward-going particles are observed to scale in a simple p/sub perpendicular/-dependent longitudinal variable. Forward-going (beam) jets are observed to be tilted away from the original direction by an amount which agrees with muon-pair data when interpreted in a parton (quantum-chromodynamics) model.

38964 Search for direct photon production in 200 and 300 GeV/c proton-beryllium interactions. Baltrusaitis, R.M.; Binkley, M.; Cox, B.; Kondo, T.; Murphy, C.T.; Yang, W. (Fermi National Accelerator Lab., Batavia, IL (USA)); Ettlinger, L.; Goodman, M.S. *Phys. Lett., B;* **88**: No. 3/4, 372-378(17 Dec 1979).

A search has been made for direct photon production in pBe interaction at 200 and 300 GeV/c over the kinematic region $1.5<$P/sub perpendicular/ < GeV/c and $-0.7<$ X/sub F/ $<0(90^\circ<$ theta /sub cms/ $<160^\circ)$. An excess of single photons above that which is predicted from the measured π^0 and eta^0 production is observed.

The ratio of γ/π^0 production is calculated assuming that the excess arises from direct photon production. We find that this ratio averages 0.070 +- 0.025 (including systematic errors) in this region of X/sub F/ and P/sub perpendicular/ for our 200 and 300 GeV/c data. We have used our measured value of the eta/π^0 ratio of 0.47 +- 0.10 in the determination of the γ/π^0 ratio. The variation of γ/π^0 with X/sub F/, P/sub perpendicular/, X/sub R/ and theta/sub cms/ is presented.

38965 Observation of a pair decay of short-lived neutral particles produced in 400 GeV/c proton interactions. Ushida, N. (Faculty of Education, Aichi University of Education - Kariya, Aichi, Japan); Fuchi, H.; Hoshino, K.; Kuramata, S.; Niu, K.; Niwa, K.; Shibuya, H.; Tasaka, S.; Yanagisawa, Y. . *Lett. Nuovo Cim.;* **23**: No. 16, 577-585(16 Dec 1979).

A pair decay of short-lived particles was observed among secondary particles of 312 interactions induced by protons of 400 GeV/c in the emulsion chambers exposed at the Fermi National Accelerator Laboratory. Lifetime is on order of 10^{-14} to 10^{-12} sec, and the production cross section is a few tens of microbarns.

38966 Argonne: neutron spin force opposite to proton. *CERN Cour.;* **19**: No. 8, 351-352(Nov 1979).

Some unexpected results on nucleon spin forces are reported. Recent experiments at the Argonne Zero Gradient Synchrotron suggest that proton-proton spin forces are stronger than previously believed and that the neutron spin force is opposite to that of the proton. (W.D.L.).

38967 First measurement of the Ξ^0 magnetic moment. Bunce, G. (Brookhaven National Lab., Upton, NY (USA)); Overseth, O.E.; Cox, P.T.; Dworkin, J.; Heller, K. (Michigan Univ., Ann Arbor (USA). Dept. of Physics); Devlin, T. *Phys. Lett., B;* **86**: No. 3-4, 386-390(8 Oct 1979).

The magnetic moment of the Ξ^0 hyperon has been measured to be μsub(Ξ^0)=-1.20+-0.06 μsub(N).

38968 X-particles and their backgraounds in 400 GeV/c proton interactions. Fuchi, H.; Hoshino, K.; Kuramata, S.; Niu, K.; Niwa, K.; Tasaka, S.; Yanagisawa, Y. (Nagoya Univ. (Japan). Dept. of Physics); Ushida, N. *Nuovo Cim., A;* **51**: No. 1, 18-32(1 May 1979).

Seven emulsion chambers were exposed to the 400 GeV/c proton beam at the Fermi National Accelerator Laboratory in order to search for further evidence of the X-particles, massive and short-lived particles. 17488 tracks of charged secondary particles from 1008 interactions were examined. Out of 21.8m of track length followed, 58 secondary phenomena were observed in the vicinity of the beam interactions. Observed secondary phenomena were analyzed statistically to extract the signal of the X-particle from the backgrounds. One statjstical candidate was found in addition to one semi-leptonic multibody decay of the X-particle. Production cross-section of the X-particles at 400 GeV/c was estimated to be a few tens of microbarns.

STRONG MESON-INDUCED INTERACTIONS

REFER ALSO TO CITATION(S) 38995

38969 (LBL—11150) **N and Δ resonances: an experimental review.** Kelly, R.L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1980. Contract W-7405-ENG-48. 19p. (CONF-800763—2). NTIS, PC A02/MF A01.

From Baryon 80 conference; Toronto, Canada (14 Jul 1980).

Experimental progress in N and Δ resonances since the Oxford baryon conference is reviewed. The review concentrates on hadronic channels, and on developments of the last one or two years. The topics reviewed include the antiproton lifetime; the Δ^{++} magnetic moment; measurements of πN elastic and charge-exchange scattering in the Δ region, the eta n threshold region, and the high-mass region; partial wave analyses of $\pi N \rightarrow \pi N$; measurements of two-body inelastic πN scattering; and isobar analyses of $\pi N \rightarrow \pi\pi N$. 75 references, 3 figures, 4 tables.

38970 Peripheral production and decay of K^0/sub S/K^0/sub S/ in the reaction $\pi^- p \rightarrow$ K^0/sub S/K^0/sub S/+neutralsat 15.4 GeV/c. Gottesman, S.R.; Fainberg, A.; Goldberg, M.; Horwitz, N.; Moneti, G.C.; Weygand, D.P.; Whitman, R.; Jacobs, S.M.; Kirsch, L.E.; Moore, S.C.; Schmidt, P.E.; Donaldson, C.J.; Gordon, c.A.; Morris, G.R.; Davis, T.; Meadows, B.T. (Sectionyracuse University, Syracuse, New York 13210). *Phys. Rev., D;* **22**: No. 7, 1503-1512(1 Oct 1980).

We report on a moment analysis of the angular distribution of K/sub S/K/sub S/ peripherally produced in the reaction $\pi^- p \rightarrow$ K/sub S/K/sub S/+(n or Δ^0) at 15.4 GeV/c. The data suggest the possible presence of a small, resonating, spin-4 K/sub S/K/sub S/ partial wave in the K/sub S/K/sub S/ mass region 1.9 to 2.0 GeV/c^2.

38971 Observations of the D and E mesons and possible three-kaon enhancements in $\pi^- p \rightarrow K^0 K^{+-} \pi^{-+}$ X, $K^0 K^+ K^-$ X at 50 and 100 GeV/c. Bromberg, C.; Dickey, J.O.; Fox, G.; Gomez, R.; Kropac, W.; Pine, J.; Stampke, S.R.; Haggerty, H.; Malamud, E.; Abrams, R.; Delzenero, R.; Goldberg, H.; Lopez, F.; Margulies, S.; McLeod, D.; Solomon, J.; Dzierba, A.; Fredericksen, F.; Heinz, R.; Krider, J.; Martin, H.; Petersen, D. (California Institute of Technology, Pasadena, California 91125). DE-AC-03-79ER0068;DE-AS02-76-EY-02009. *Phys. Rev., D;* **22**: No. 7, 1513-1529(1 Oct 1980).

We present results from the study of multikaon final states in the reactions $\pi^- p \rightarrow K^0 K^{+-} \pi^{-+}$ X, $K^0 K^+ K^-$ X at 50 and 100 GeV/c. Here X is semi-inclusive, that is, a specific forward topology and an interaction registering in the counters surrounding the target are required. The D(1285) meson is seen in the $\delta\pi$ mode, while the E(1420) meson is observed in both the $\delta\pi$ and the K*K modes. In addition, there are two possible enhancements in the three-kaon final state. The first (M~1840 MeV) is associated with the K^{0}phi mode and is consistent with being the charmed D^0. The second, a K* state (M=2003 +- 14 MeV, Γ=87 +- 43 MeV), decays into KA_2.

38972 Observation of a narrow hyperon state of mass 3.17 GeV. Amirzadeh, J.; Ansorge, R.E.; Baubillier, M.; Bloodworth, I.J.; Bossen, G.J.; Burns, A.; Carney, J.N.; Carter, J.R.; Cowan, C.A.; Cox, G.F. *Phys. Lett., B;* **89**: No. 1, 125-130(31 Dec 1979).

We present evidence for a narrow Y* with a mass of 3.17 GeV and a width <= 20 MeV decaying to ΣKK anti + pions, ΛK anti K + pions and ΞK + pions. The data come from two high-statistics K$^-$p bubble chamber experiments with a sensitivity of approx. 100 eV/μb at 8.25 GeV/c and approx. 45 eV/μb at 6.5 GeV/c.

38973 Production and decay angular distributions of the Y*(1385) in the line-reversed reactions: $\pi^+ p \rightarrow K^+$ Y*(1385) and $K^- p \rightarrow \pi^-$ Y*(1385) at 11.5 GeV/c. Cautis, C.V.; Ballam, J.; Bouchez, J.; Carroll, J.T.; Chadwick, G.B.; Chaloupka, V.; Field, R.C.; Freytag, D.R.; Lewis, R.A.; Minard, M.N. *Nucl. Phys., B;* **156**: No. 3, 507-531(10 Sep 1979).

The authors have measured in a single experimental setup the differential cross sections and decay angular distribution of the Y*(1385) produced in the two line-reversed reactions: $\pi^+ p \rightarrow K^+ Y^{*+}(1385)$(279 events/$\mu$b) and $K^- p \rightarrow \pi^- Y^{*+}(1385)$(190 events/$\mu$b) at 11.5 GeV/c. The data have been derived from a triggered bubble-chamber experiment using the SLAC Hybrid Facility. The differential cross sections and Y* polarizations for the two reactions are found to be in agreement with exchange-degeneracy predictions, if kinematic differences are taken into account. The Stodolsky-Sakurai and additive quark model predictions are in agreement with the main features of the decay angular distributions of the Y*(1385), except for small violations at low momentum transfer, which can be associated with a finite helicity non-flip contribution in the forward direction.

PARTICLE INTERACTIONS AND PROPERTIES - THEORETICAL

REFER ALSO TO CITATION(S) 39001

38974 (DOE/ER/02009—140) **Theoretical particle physics. Progress report, December 1, 1079-November 30, 1980.** Hendry, A.W.; Lichtenberg, D.B.; Weingarten, D.H. (Indiana Univ., Bloomington (USA). Dept. of Physics). Aug 1980. Contract AS02-76ER02009. 16p. NTIS, PC A02/MF A01.

Work during the past year ranged from phenomenological studies of various quark systems to applications of quantum chromodynamics and lattice gauge theories. On the phenomenological side for mesons, studies of the charmonium and bottomonium families as well as the spectrum of states containing a single b-quark continued. As a result of some improved measurements, the topic of baryon magnetic moments was reconsidered. At the same time the properties of highly excited 3-quark systems were considered in view of the recent confirmation of resonances with spins up through 21/2. Quark configurations allowing for N colors were also studied, where N was varied. In the area of gauge field theories on a lattice, several interesting connections between gauge theories and interacting string models were found. Monte Carlo techniques were developed to study the problem of quark confinement, by means of a lattice version of QCD. Lastly, a new approach to the problem of quantizing gravity was started.

38975 (DOE/ER/02271—103) **Theoretical high energy physics. Progress report, May 1, 1979-April 30, 1980.** Lee, T.D. (Columbia Univ., New York (USA). Dept. of Physics). Jun 1980. Contract AC02-76ER02271. 22p. NTIS, PC A02/MF A01.

Research activities for the year are sketched in this administrative document. References to publications are given. (RWR)

38976 Electroweak contributions to quark masses. Kiskis, J.; West, G.B. (Theoretical Division, Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87545). *Phys. Rev. Lett.;* **45**: No. 10, 773-776(8 Sep 1980).

The divergences in lowest-order electroweak contributions to quark masses are discussed. The example model of U(1)/sub em/ xSU(3)/sub color/ is worked out. If the bare mass and color coupling constant are constrained to be independent of the electromagnetic coupling, as is natural, then the lowest-order electromagnetic shifts of the renormalized mass and strong coupling will be infinite. This is the expected result and is true even though we treat the strong interactions to all orders and thereby incorporate the relatively soft ultraviolet behavior of quantum chromodynamics.

GENERAL

REFER ALSO TO CITATION(S) 39000

38977 (FERMILAB-CONF—80/74-THY) **Prospects for supergravity.** Zumino, B. (Fermi National Accelerator Lab., Batavia, IL (USA); European Organization for Nuclear Research, Geneva (Switzerland)). Aug 1980. Contract AC02-76CH03000. 6p. (CONF-800724—24). NTIS, PC A02/MF A01.

From 20. international conference on high energy physics; Madison, WI, USA (17 Jul 1980).

Present particle phenomenology appears to be successfully described by a renormalizable gauge theory based on the low-energy group SU(3)/sub color/ x SU(2)/sub left/ x U(1). The three effective coupling constants of this theory vary with energy according to the renormalization group equations and become approximately equal at an energy of about 10^{14} - 10^{15} GeV, where one can attempt a grand unified theory (GUT) based on a gauge group with only one coupling constant and containing the low-energy group. The grand unification energy is very large and not much smaller than the Planck mass m/sub P/≅ 10^{19} GeV, where gravity becomes important. A natural way to unify gravity with lower-spin fields is provided by supergravity, the supersymmetric extension of Einstein's gravity. The largest supergravity theory (largest theory with a supermultiplet with maximum spin not exceeding two) is the N = 8 theory (N is the number of supersymmetries), which has an SO(8) internal symmetry. A GUT with N = 8 supergravity is considered. (RWR)

38978 Addendum to "Gluon final states in Higgs-boson decay". Rizzo, T.G. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973). DE-AC02-76CH00016. *Phys. Rev., D;* **22**: No. 7, 1824-1825(1 Oct 1980).

In an earlier paper the average values of spherocity, <S>, and thrust, <1-T>, were calculated for the process H→qq-bar+gluon for massless quarks. In this Addendum we investigate the influence of quark masses on the average values of these two variables.

38979 SU(N) grand unification with several quark-lepton generations. Frampton, P.H. (Ohio State Univ., Columbus (USA). Dept. of Physics). *Phys. Lett., B;* **88**: No. 3/4, 299-301(Dec 1979).

Procedures are given for embedding SU(5) into SU(N) such that several SU(5) generations remain as ordinary-mass fermions. Examples with an arbitary number of generations occur already for SU(7). All models have only quarks and leptons, without quixes or quaights.

ELECTROMAGNETIC INTERACTIONS

38980 E_6 model with composite muon and tau families. Shaw, G.L.; Slansky, R. (Physics Department, University of California, Irvine, California 92717). *Phys. Rev., D;* **22**: No. 7, 1760-1774(1 Oct 1980).

We present a unified model based on the exceptional group E_6 in which the electron family (e, ν/sub e/, u, and d′, where the prime denotes a Cabibbo-rotated state) is elementary, and the μ and tau families are composites. The model has a rich particle spectrum starting not far above the tau family and a range of mass scales above the weak-boson masses. Group-theoretical features of the symmetry breaking are discussed in some detail in a language having many other applications.

38981 Quark-vacuum scattering. Donoghue, J.F. (Center for Theoretical Physics, Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). EY-76-C-02-3069. *Phys. Rev., D;* **22**: No. 7, 1780-1786(1 Oct 1980).

It has been suggested that there are two phases of the quantum-chromodynamic vacuum: the perturbative vacuum and the complex true vacuum. In this framework, I demonstrate a new mechanism for particle production in deep-inelastic reactions: excitation of pions by the phase change of the vacuum induced by separating quark color charges. This process, quark-vacuum scattering, is discussed in general, and a simple model is examined in detail.

WEAK INTERACTIONS

REFER ALSO TO CITATION(S) 38976, 38980, 39106

38982 Limits on charm-changing neutral currents. Buccella, F. (Rome Univ. (Italy). Istituto di Fisica); Oliver, L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). *Nucl. Phys., B;* **162**: No. 2, 237-249(Jan 1980).

From data on D^0, anti D^0 decays, we get an upper limit on the mass difference delta m of the two CP eigenstates. Due to a critical dependence of delta m on QCD corrections, this bound cannot exclude large (gL,gR) charm-changing neutral couplings. Limits on neutrino production of charm by neutral currents and of charm decay into e^+e^- + hadrons are then necessary to constrain the couplings further. However, if the (c,u) current is assumed to be pure left handed, delta m gives the severe bound /g/sub L// < 0.6 x 10^{-3}. This is a confirmation of the Glashow-Iliopoulos-Maiani mechanism in the charm sector.

38983 (SLAC-PUB—2596) **Role of nonspectator interactions in charm and bottom decays.** Barger, V.; Leveille, J.P.; Stevenson, P.M. (Wisconsin Univ., Madison (USA). Dept. of Physics; Stanford Linear Accelerator Center, CA (USA)). Aug 1980. Contract AC04-76DP00789. 6p. (CONF-800724—33). NTIS, PC A02/MF A01.

From 20. international conference on high energy physics; Madison, WI, USA (17 Jul 1980).

The role of annihilation and exchange diagrams in charmed meson, Λ^+/sub c/, and B meson decays is analyzed. 5 figures.

38984 Semileptonic decay of charmed particles and weak form factors. Yamada, K. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *Phys. Rev., D;* **22**: No. 7, 1676-1693(1 Oct 1980).

We present a phenomenological analysis of semileptonic decays of charmed particles based on SU(4) symmetry and (axial-) vector-meson dominance of weak form factors. The modified monopole form factors, which have been recently discussed by Sehgal, are extensively applied for charmed-particle decays throughout this work. These form factors contain an as yet undetermined parameter. We find a precise quantitative relation, depending on this parameter, between semileptonic decay rates and production cross sections of charmed baryons in neutrino-induced quasielastic scattering. The preliminary data on the latter processes suggest that either (i) form factors decrease in the spacelike region much faster than previously expected, or (ii) the Cabibbo factor is considerably smaller than the conventional value assumed for production processes of charmed baryons, i.e., $\sin^2\theta << 0.05$. We also discuss a few methods to test the basic hypotheses underlying this work.

38985 Study of charmed-quark production by antineutrinos. Barish, S.J.; Brock, R.; Engler, A.; Kikuchi, T.; Kraemer, R.W.; Messing, F.; Stacey, B.J.; Tabak, M.; Derrick, M.; Gregory, P.; LoPinto, F.; Musgrave, B.; Schlereth, J.; Schreiner, P.; Singer, R.; Barnes, V.E.; Carmony, D.D.; Fernandez, E.; Garfinkel, A.; Laasanen, A.T. (Carnegie-Mellon University, Pittsburgh, Pennsylvania 15213). *Phys. Rev. Lett.;* **45**: No. 10, 783-786(8 Sep 1980).

This Letter presents the x and y distributions of events with visible strange particles produced in charged-current nu-barp interactions. It is shown that charmed-particle production via the process nu-bar/sub μ/s-bar→μ^+ c-bar is required. Using a simple model, we obtain, for the proton, $\int xs\text{-bar}(x)dx = 0.007 \pm 0.002$ and $\int xs\text{-bar}(x)dx / \int xu(x)dx = 0.019 \pm 0.006$ in the kinematic region $0.05 < x <$ or $= 0.8$ and $0.1 < y <$ or $= 0.8$. Moreover, these observations require a significant left-handed component for the (/sup c// sub s/) doublet.

38986 Consequences of Majorana and Dirac mass mixing for neutrino oscillations. Barger, V.; Langacker, P.; Leveille, J.P.; Pakvasa, S. (Department of Physics, University of Wisconsin at Madison, Madison, Wisconsin 53706). DE-AC02-76ER00881;C00-881-149;DE-AC03-76ER00511. *Phys. Rev. Lett.;* **45**: No. 9, 692-695(1 Sep 1980).

This Letter considers a second class of neutrino oscillations which can arise when both Majorana and dirac neutrino mass terms exist. These oscillations mix neutrino members of weak current doublets with singlets of the same chirality. A depletion of a neutrino beam results, with apparent nonconservation of probability. Possible relevance to current oscillation experiments is discussed.

38987 Why are the isoscalar neutral current axial-vector couplings and isoscalar nucleon anomalous moments small. Oneda, S.; Tanuma, T. (Maryland Univ., College Park (USA). Center for Theoretical Physics); Slaughter, M.D. (Los Alamos Scientific Lab., NM (USA). Theoretical Div.). *Phys. Lett., B;* **88**: No. 3/4, 343-348(17 Dec 1979).

By using an argument based on the realization of chiral current algebras, we explain why the isoscalar neutral current axial-

vector coupling and the isoscalar nucleon anomalous moments are small. We give an argument which predicts (G/sub A//sup N/(0))/sub p/(G/sub A//sup N/(0))/sub n/ = (H/sub A//sup N/(0))/sub p/(H/sub A//sup N/(0))/sub n/ = k/sub p//k/sub n/ ~ 1.79/-1.91, where k/sub p/ and k/sub n/ are the anomalous moments of the proton and neutron, respectively. (G/sub A//(0))/sub p/ and H/sub A//sup N/(0))/sub p/ are the weak neutral current axial-vector coupling and the induced pseudoscalar coupling for the proton, respectively.

38988 Conservation or violation of B-L in proton decay. Wilczek, F. (Princeton Univ., NJ (USA). Dept. of Physics); Zee, A. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). ET-76C023072; AT(E11-1)3071. *Phys. Lett., B;* **88**: No. 3/4, 311-314(17 Dec 1979).

The question of whether or not proton decay conserves baryon minus lepton number is studied. We argue that observation of B - L violation would indicate the existence of physical structure in the mass scale between M/sub w/ approx. 10^2 GeV and M/sub x/ approx. 10^{16} GeV, contrary to the usual supposition about grand unification.

38989 Evidence for factorization and coupling constant determination in neutral-current processes. Hung, P.Q. (Fermi National Accelerator Lab., Batavia, IL (USA)); Sakurai, J.J. (California Univ., Los Angeles (USA). Dept. of Physics). *Phys. Lett., B;* **88**: No. 1/2, 91-96(Dec 1979).

A combined analysis of recent neutral-current results - neutrino-hadron, neutrino-electron, polarized-electron-deuteron, heavyatoms - provides, for the first time, confirming evidence for factorization in the neutral-current interactions. The factorization hypothesis is then used to determine uniquely various coupling parameters.

38990 Quark recombination amplitudes and the decays of charmed mesons. Jagannathan, K.; Mathur, V.S. (Rochester Univ., NY (USA). Dept. of Physics and Astronomy). Contract EY-76-C-02-3065. *Phys. Lett., B;* **88**: No. 3/4, 335-338(Dec 1979).

We present an ansatz for calculating quark recombination amplitudes in the decay of charmed pseudoscalar mesons. We calculate the decay widths and branching ratios of several exclusive modes of D^0, D^+ and F^+ decays using the free quark model with appropriate enhancement factors from QCD.

38991 Quark and particle helicities in hadronic charmed particle decays. Koerner, J.G. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)); Goldstein, G.R. (Science Research Council, Chilton (UK). Rutherford Lab.). *Phys. Lett., B;* **89**: No. 1, 105-110(Dec 1979).

We investigate possibilities of obtaining information on the chirality of the charm-changing current (anti cs) by measuring the helicities of hadrons with spin in exclusive hadronic charmed particle decays.

STRONG INTERACTIONS, GENERAL

REFER ALSO TO CITATION(S) 39008

38992 Structure of hadron structure functions. De Rujula, A.; Martin, F. (Center for Theoretical Physics, Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology,Cambridge, Massachusetts 02139). DE-AC02-76ER03069. *Phys. Rev., D;* **22**: No. 7, 1787-1808(1 Oct 1980).

We investigate the comparison of the shapes, as functions of x, of nonsinglet structure functions of pions and nucleons, F/sub pi,N/(x,Q^2). We argue that we can predict (to leading twist, all orders of quantum-chromodynamic perturbation theory) the shape of a pion structure function in terms of the observed shape of the nucleon structure function at the same Q^2. The uncertainties due to our ignorance of the details of bound-state dynamics are at the 20% level. Our technology is to exploit in detail the relationship between two approaches to the description of structure functions: the operator-product expansion and the covariant parton model.

STRONG INTERACTIONS, BARYON NO.=0

REFER ALSO TO CITATION(S) 39006

38993 Isospin-violating mixing in meson nonets. Isgur, N. (Toronto Univ., Ontario (Canada). Dept. of Physics); Rubinstein, H.R.; Schwimmer, A. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.); Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Physics); Lipkin, H.J. . *Phys. Lett., B;* **89**: No. 1, 79-83(Dec 1979).

Segregation into ideally mixed nonets results when the OZI-violating interaction which would mix u anti u, d anti d, and s anti s mesons into isospin and SU(3) eigenstates is much weaker than the s anti s-d anti d mass difference. We show that the d anti d-u anti u mass difference can begin to induce a similar segregation into d anti d and anti u mesons which leads to large isospin violations. An experimental example of such large isospin breaking (approx. 30%) which we predict has probably already been seen in f → K anti K.

38994 Program for construction of a Regge theory with crossing symmetry and unitarity. Warnock, R.L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). *Physica, A;* **96**: No. 1-2, 321-326(Apr 1979).

A scheme for construction of a crossing-symmetric, unitary Regge theory of meson-meson scattering is reviewed. The construction proceeds by solution of the non-linear crossing-unitarity equations in a new formulation based entirely on partial waves. The high-energy divergences encountered in earlier formulations are avoided.

STRONG INTERACTIONS, BARYON NO.=1

REFER ALSO TO CITATION(S) 39103

38995 Localized particle production in the beam and target fragmentation regions. Leedom, I.D.; Moser, A.R.; Gaidos, J.A. (Department of Physics, Purdue University, West Lafayette, Indiana 47907). *Phys. Rev., D;* **22**: No. 7, 1815-1818(1 Oct 1980).

Results are presented from three high-energy reactions that pertain to hadron production from excited beam and target particles when angular distributions are viewed in a particular frame. These results are discussed in light of a recent conjecture concerning the angular asymmetry expected from particle emission from a localized area on the emitting hadron.

38996 Isospin violation in πN scattering from π^0-eta mixing. Cutkosky, R.E. (Carnegie-Mellon Univ., Pittsburgh, PA (USA)). Contract EY-76-02-3066. *Phys. Lett., B;* **88**: No. 3/4, 339-342(Dec 1979).

Contributions to charge-exchange scattering from π^0 -eta mixing are studied and found to be generally very small. It would usually be safe to assume isospin conservation in πN partial wave analysis. However, special enhancement mechanisms associated with the S_{11} resonance N*(1540) lead to the prediction of a significant effect at 650-900 MeV/c. Verification of this effect would test various π^0 -eta mixing models and also provide structural information about the N*(1540).

STRONG INTERACTIONS, BARYON NO. GREATER THAN 1

38997 Complete relativistic Faddeev calculations of pion-deuteron scattering. Garcilaza, H. (Physics Department, Texas A&M University, College Station, Texas 77843). DE-AS05-76ER05223. *Phys. Rev. Lett.;* **45**: No. 10, 780-782(8 Sep 1980).

Pion-deuteron elastic scattering in the region of the (3,3) resonance is calculated with two covariant reductions of the relativistic Faddeev equations. The two S-wave nucleon-nucleon channels and the six S- and P-wave pion-nucleon channels are included by means of separable T matrices. Both of the space and the spin variables are treated relativistically, by use of the three-body helicity formalism of Wick. The results agree very well with the data at 142 and 182 MeV, but do not resolve the discrepancy at 256 MeV.

PARTICLE INVARIANCE PRINCIPLES AND SYMMETRIES

APPLICATIONS TO ELECTROMAGNETIC AND WEAK INTERACTIONS

REFER ALSO TO CITATION(S) 39000

38998 (SLAC-PUB—2574) CP violation in the six-quark model. Wise, M.B. (Stanford Linear Accelerator Center, CA (USA)). Jul 1980. Contract AC03-76SF00515. 8p. (CONF-800724—31). NTIS, PC A02/MF A01.

From 20. international conference on high energy physics; Madison, WI, USA (17 Jul 1980).

Some of the recent work on CP violation in the six-quark model is reviewed.

38999 Pseudoscalar decay constants and eta→3π in chiral and 1/N perturbation theory. Milton, K.A.; Palmer, W.F.; Pinsky, S.S. (Department of Physics, The Ohio State University, Columbus, Ohio 43210). *Phys. Rev., D;* **22**: No. 7, 1647-1651(1 Oct 1980).

The normal and anomalous chiral Ward identities are reexamined from the point of view of chiral and 1/N perturbation theory. Constraints of psi→etaγ and psi→eta′γ and pseudoscalar two-photon decays are imposed, yielding a system of six simultaneous equations. A solution for the pseudoscalar decay constants is found which is relatively insensitive to the quantum-chromodynamic surface term.

The decay eta→3π is then calculated using these results, with good agreement with recent measurements.

APPLICATIONS TO STRONG INTERACTIONS

39000 (DOE/ER/03992—412) **Sequential internal supersymmetry.** Ne'eman, Y.; Sternberg, S. (Texas Univ., Austin (USA). Center for Particle Theory; Tel Aviv Univ. (Israel)). Sep 1980. Contract AS05-76ER03992. 4p. NTIS, PC A02/MF A01.

The supergroups SU(2/1), SU(5/1) and SU(5 = k/1) provide fitting classifications, unifying weak-electromagnetic, color, and sequential flavor, respectively.

FIELD THEORY

REFER ALSO TO CITATION(S) 38974, 38976, 38977, 38980, 38981, 38999, 39082, 39103

39001 (COO—3130TA-352) **Progress report for a research program in theoretical high-energy physics.** Feldman, D.; Fried, H.M.; Guralnik, G.S.; Jevicki, A.; Kang, K.; Tan, C.I. (Brown Univ., Providence, RI (USA). Dept. of Physics). 1 Oct 1980. Contract AC02-76ER03130. 19p. NTIS, PC A02/MF A01.

The past year's research has dealt with a wide range of topics in High-Energy Theoretical Physics. Important new results have been found in the fields of large-N expansions in quantum field theories via an effective Hamiltonian technique, and by the method of classical field equations supplemented by quantum boundary conditions; finite lattice QCD at N/sub c/ = ∞; neutrino oscillations and natural flavor conservation in gauge theory; the vanishing of the renormalized effective potential in phi$_4^4$ theory; a new method for treating singular differential equations; and an infrared cluster expansion in quantum field theory. In addition, substantial progress has been made in the analyses of lattice gauge theories; studies of factorization properties of mass and infrared singularities in QCD: non-hermitian quantum problems in the context of Gribov field theories; symmetry breaking via contracted groups; the calculation of Cabibbo-type angles and grand unification theories; and strong-coupling methods in gauge and nongauge field theories, using a systematic, lattice-formulated, perturbation theory, and by the extraction of relevant infrared structure.

39002 (DOE/ER/01545—282) **Neutrino mixing in SO(10).** Milton, K.; Hama, S.; Nandi, S.; Tanaka, K. (Ohio State Univ., Columbus (USA). Dept. of Physics). 1980. Contract AC02-76ER01545. 6p. NTIS, PC A02/MF A01.

Neutrino mixing angles were computed in terms of upquark mass ratios in a grand unified field theory based on the gauge group SO(10) supplemented by a discrete symmetry. Only large ν/sub μ/-ν/sub tau/ mixing were found.

39003 (DOE/ER/01545—283) **Neutrino mixing and oscillation in a grand unified field theory SO(10).** Tanaka, K. (Ohio State Univ., Columbus (USA). Dept. of Physics). 1980. Contract AC02-76ER01545. 12p. NTIS, PC A08/MF A01.

The investigation shows that it is very difficult to achieve neutrino mixing of other than the V/sub μ/-ν/sub tau/ type in any minimal SO(10) model in which neutrino masses are generated by the Gell-Mann-Ramond-Slansky mechanism, because of the severe constraints placed on the mass matrix by quark phenomenology.

39004 (DOE/ER/03992—413) **Geometric ghosts and unitarity.** Ne'eman, Y. (Texas Univ., Austin (USA). Center for Particle Theory; Tel Aviv Univ. (Israel)). Sep 1980. Contract AS05-76ER03992. 5p. NTIS, PC A02/MF A01.

A review is given of the geometrical identification of the renormalization ghosts and the resulting derivation of Unitarity equations (BRST) for various gauges: Yang-Mills, Kalb-Ramond, and Soft-Group-Manifold.

39005 (FERMILAB-CONF—80/71-THY) **Condensation of (G/sub $\mu\nu$//sup a/)^2 in quantum chromodynamics.** Kazama, Y. (Fermi National Accelerator Lab., Batavia, IL (USA)). Aug 1980. Contract AC02-76CH03000. 4p. (CONF-800724—25). NTIS, PC A02/MF A01.

From 20. international conference on high energy physics; Madison, WI, USA (17 Jul 1980).

The property of the QCD vacuum is discussed by focusing on the expectation value of the color-singlet composite operator (G/sub $\mu\nu$//sup a/)^2, the square of the gluon field strength tensor. (G/sub $\mu\nu$//sup a/)^2 condenses quite generally without the assumption of dominance of certain configurations. In the true non-perturbative vacuum of QCD, (G/sub $\mu\nu$//sup a/)^2 condenses with positive (magnetic) sign. 1 figure. (RWR)

39006 (LBL—11365) **Gauge invariant description of heavy quark bound states in quantum chromodynamics.** Moore, S.E. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1980. Contract W-7405-ENG-48. 118p. NTIS, PC A06/MF A01.

A model for a heavy quark meson is proposed in the framework of a gauge-invariant version of quantum chromodynamics. The field operators in this formulation are taken to be Wilson loops and strings with quark-antiquark ends. The fundamental differential equations of point-like Q.C.D. are expressed as variational equations of the extended loops and strings. The 1/N expansion is described, and it is assumed that nonleading effects such as intermediate quark pairs and nonplanar gluonic terms can be neglected. The action of the Hamiltonian in the $A_0 = 0$ gauge on a string operator is derived. A trial meson wave functional is constructed consisting of a path-averaged string operator applied to the full vacuum. A Gaussian in the derivative of the path location is assumed for the minimal form of the measure over paths. A variational parameter is incorporated in the measure as the exponentiated coefficient of the squared path location. The expectation value of the Hamiltonian in the trial state is evaluated for the assumption that the negative logarithm of the expectation value of a Wilson loop is proportional to the loop area. The energy is then minimized by deriving the equivalent quantum mechanical Schroedinger's equation and using the quantum mechanical 1/n expansion to estimate the effective eigenvalues. It is found that the area law behavior of the Wilson loop implies a nonzero best value of the variational parameter corresponding to a quantum broadening of the flux tube.

39007 (SLAC-PUB—2540) **Hadronic wave function in quantum chromodynamics.** Brodsky, S.J.; Huang, T.; Lepage, G.P. (Stanford Linear Accelerator Center, CA (USA); Cornell Univ., Ithaca, NY (USA). Lab. of Nuclear Studies). 1980. Contract AC03-76SF00515. 22p. (CONF-800724—28). NTIS, PC A02/MF A01.

From 20. international conference on high energy physics; Madison, WI, USA (17 Jul 1980).

The underlying link between hadronic phenomena in quantum chromodynamics at large and small distance is the hadronic wavefunction. The theoretical and empirical constraints on the hadronic wave-function and hadronic structure functions; the predictions of perturbative QCD for the large transverse momentum tail of the Fock state infinite momentum wavefunction psi (k/sub perpendicular to i/,x/sub i/,s/sub i/); the valence Fock state meson wavefunctions from the meson decay; the evolution equations of the distribution amplitudes; and a simplified model for the basic wavefunctions are presented. In particular, a new type of low energy theorem is obtained for the pion wavefunction from the $\pi^0 \to \gamma\gamma$. This result, together with the constraint on the valence wavefunction from the $\pi^0 \to \mu\nu$ decay, leads to the probability of finding the valence vertical bar q anti q > state. All these constraints allow construction of a possible model which describes hadronic wavefunctions, probability amplitudes, and distributions. Results are compared with data for form factors and the deep inelastic processes. This work represents a first attempt to construct a model of hadronic structure which is consistent with data and QCD at large and small distances.

39008 **Study of a model Lagrangian in QCD for soft bag.** Fukuda, R. (Fermi National Accelerator Lab., Batavia, IL (USA)); Igarashi, Y. (Bielefeld Univ. (Germany, F.R.). Abt. Theoretische Physik). *Z. Phys. C*; 3: No. 4, 307-312(1980).

The effective Lagrangian of Kogut, Susskind and 't Hooft is examined in connection with interpretation of the additional scalar field as a gluon-pairing field. The pairing effect on the short-distance potential is found to be small. A bag limit of the Lagrangian is investigated. Integral representations for interquark potential and nontrivial bag shape are given for heavy quark-antiquark bag states.

PHYSICS RESEARCH

NUCLEAR PHYSICS

REFER ALSO TO CITATION(S) 39105

39009 (LA-UR—80-2684) **Processing needs and constraints: neutron data processing.** MacFarlane, R.E. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 4p. (CONF-800979—7). NTIS, PC A02/MF A01.

From Workshop on nuclear data evaluation methods and procedures; Upton, NY, USA (22 Sep 1980).

New applications for processed data and increased accuracy requirements have generated needs for change in the Evaluated Nuclear Data Files (ENDF). Some constraints must be removed to allow this growth to take place, but other strong constraints must remain to protect existing users.

39010 (LBL—9711) **Nuclear science. Annual report, July 1, 1978-June 30, 1979.** Gough, R.A.; Nurmia, M.J.; Westfall, G.D. (eds.). (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Mar 1980. Contract W-7405-ENG-48. 275p. NTIS, PC A12/MF A01.

This Annual Report of the Nuclear Science Division describes the scientific research that has been carried out within the Division during the period between July 1, 1978 and June 30, 1979. The principal objective of the Nuclear Science Division continues to be the experimental and theoretical investigation of the interactions of heavy ions with target nuclei, both for their intrinsic application in developing understanding of microscopic and macroscopic nuclear science and for their use in the synthesis of new exotic isotopes and new chemical elements. Complementary programs in light ion nuclear science, in nuclear data compilations, and in advanced instrumentation development are also pursued. The Division operates the 88-inch cyclotron as a major research facility which also supports a strong outside user program; experimentalists within the Division also use the Super HILAC and the Bevalac accelerators for their studies. Experimental research was carried out on nuclear structure, nuclear reactions and scattering, and relativistic heavy ions (projectile and target fragmentation, central collisions), with lesser effort devoted to atomic physics, the isotopes project, and other activities. The theoretical study of nuclear collisions involved both nonrelativistic and relativistic reactions. Other work was devoted to the subjects of accelerator operations and development and nuclear instrumentation. Publications lists are also included. 30 items with significant information were abstracted and indexed individually. (RWR)

39011 **Future directions in studies of nuclei far from stability.** Hamilton, J.H.; Spejewski, E.H.; Bingham, C.R.; Zganjar, E.F. (eds.). Contract AC05-760R00033. New York, NY; North-Holland Publishing Co. (1980). 435p. (CONF-790976—). Elsevier North-Holland, Inc., New York, $61.00.

From International symposium on future directions in studies of nuclei far from stability; Nashville, TN, USA (10 Sep 1979).

Individual abstracts were prepared for 27 of the papers in this volume. The remaining ten have already been cited in ERA; these papers can be located by reference to the entry CONF-790976— in the report number index. (RWR)

EXPERIMENTAL TECHNIQUES

REFER ALSO TO CITATION(S) 39054

39012 (CONF-800252—1) **In-beam spectroscopy of intermediate weight nuclei and Coulomb excitation of actinide nuclei.** Piercey, R.B.; Hamilton, J.H. (Vanderbilt Univ., Nashville, TN (USA). Dept. of Physics). 1980. Contract AS05-76ER05034. 60p. NTIS, PC A04/MF A01.

From 18. winter school on physics, selected topics in nuclear structure; Bielsko-Biala, Poland (11 Feb 1980).

Studies of gamma-rays emitted in beam either following the formation and subsequent decay of a compound nucleus or, at beam energies below the Coulomb barrier, following the Coulomb excitation of the target have, for the past decade, been primary sources of new information relating to the structure of the nucleus. This paper discusses some well-known techniques in detail, and reports on some exciting new techniques that have been developed in recent years. Emphasis is placed on showing how nuclear structure information can be extracted from such measurements, and how this information has, in the past decade, condensed to form a basis for understanding nuclear degrees of freedom over a broad range of nuclei. Illustrations are taken from existing literature and some unpublished results of the Vanderbilt-ORNL, Vanderbilt-UNISOR, Vanderbilt-GSI, and Vanderbilt-University of Koeln collaborations. 38 figures, 1 table.

39013 **Possibilities of studying low-energy (n,p) and (n,α) reactions in neutron deficient nuclei.** Andersson, G.; Hagberg, E. (Chalmers Univ. of Technology, Goeteborg, Sweden). pp 121-126 of Future directions in studies of nuclei far from stability. Hamilton, J.H.; Spejewski, E.H.; Bingham, C.R.; Zganjar, E.F. (eds.). New York, NY; North-Holland Publishing Co. (1980).

From International symposium on future directions in studies of nuclei far from stability; Nashville, TN, USA (10 Sep 1979).

The feasibility of studying (n,p) and (n,α) reactions in neutron-deficient nuclei was demonstrated in a series of experiments, where ISOLDE-prepared, radioactive targets were irradiated at the Grenoble high-flux reactor. Two conceivable lines of development of the field are discussed: inclusion of far-from-stability nuclides by on-line operation, that is, neutron exposure simultaneously with the target preparation; resonance spectroscopy by time-of-flight techniques at future spallation neutron sources, ultimately in an on-line mode, where the target-producing ISOL facility is fed by the same accelerator as the neutron source. 2 figures, 1 table.

39014 **Laser spectroscopy for probing nuclear structure off stability.** Otten, E.W. (Johannes Gutenberg Universitaet, Mainz, Germany). pp 177-194 of Future directions in studies of nuclei far from stability. Hamilton, J.H.; Spejewski, E.H.; Bingham, C.R.; Zganjar, E.F. (eds.). New York, NY; North-Holland Publishing Co. (1980).

From International symposium on future directions in studies of nuclei far from stability; Nashville, TN, USA (10 Sep 1979).

After an introduction on the history of hyperfine structure (hfs) and isotope shift (IS) measurements, several formulas of optical hfs and IS are reviewed. Then a detailed experimental discussion is given of those methods that have produced new data away from the stability line: laser-excited fluorescence in cells, laser-excited fluorescence from a collimated atomic beam, laser optical pumping of an atomic beam with a Stern-Gerlach analyzer, and collinear laser spectroscopy on fast beams. Results of experiments on $\delta<r^2>$ in the following areas of the periodic chart are summarized: light, neutron-rich nuclei (Na series); isotopic chains crossing the shell closures N = 50 and 82; the Hg series. Some atomic-beam magnetic resonance results from ISOLDE are also included. Possible directions for development in this field are indicated. 16 figures. (RWR)

NUCLEAR PROPERTIES AND REACTIONS, A=1-5, THEORETICAL

NUCLEAR REACTIONS AND SCATTERING

39015 (LA-UR—80-2721) **Symmetry and Coulomb corrections in light nuclear systems.** Zankel, H. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 10p. (CONF-800824—22). NTIS, PC A02/MF A01.

From 5. international symposium on polarization phenomena in nuclear physics; Santa Fe, NM, USA (11 Aug 1980).

An approximation that describes the Coulomb-nuclear interference in a two-body manner is used to calculate vector analyzing powers in elastic p-d scattering and phase shifts for p-α scattering. Comparison with experiments indicates that a good deal of the observed differences in charge-symmetric three- and five-nucleon reactions can be covered by Coulomb interference effects. Calculations for the four-nucleon system confirm this observation. It appears to be questionable that nuclear charge asymmetry has to be invoked to explain current experiments.

NUCLEAR PROPERTIES AND REACTIONS, A=1-5, EXPERIMENTAL

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 38962

39016 (LBL—9711, pp 35-36) **Analyzing power measurements in p vector + ^{3}He elastic scattering between 21 and 30 MeV.** Watson, J.W. (Kent State Univ., OH); Conzett, H.E.; Larimer, R.M.; Leemann, B.T.; Stephenson, E.J. Mar 1980.

In Nuclear science. Annual report, July 1, 1978-June 30, 1979.

Proton analyzing powers in p vector + ^{3}He elastic scattering are presented for energies of 21.44 and 30.12 MeV. A strong spin-orbit interaction sets in for this four-nucleon scattering system. 1 figure. (RWR)

39017 (UCRL—53057) **Photodisintegration of ^{3}H and ^{3}He.** Faul, D.D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Sep 1980. Contract W-7405-ENG-48. 198p. NTIS, PC A09/MF A01.

Thesis.

The photoneutron cross sections for ^{3}H and ^{3}He have been measured from threshold to ~ 25 MeV with monoenergetic photons from the annihilation in flight of fast positrons at the LLL Electron-Positron Linear Accelerator facility. These reactions include the two-body breakup of ^{3}H and the three-body breakup of both ^{3}H and ^{3}He; these measurements for ^{3}H are the first to span the energy region across the peaks of the cross sections. An efficient BF_3-tube-and-paraffin neutron detector and high-pressure gaseous samples of several moles each (the activity of the ^{3}H sample was ~ 200,000 Ci) were employed in these measurements. Measurements on ^{16}O and ^{2}H also were performed to verify the absolute cross-section scale. The results, when compared with each other and with results for the two-body breakup cross section for ^{3}He from the literature, show that the two-body breakup cross sections for ^{3}H and ^{3}He have nearly the same shape, but the one for ^{3}He lies lower in magnitude; the three-body breakup cross section for ^{3}He lies higher in magnitude and is broader in the peak region and also rises less sharply from threshold than that for ^{3}H; and these measured differences

between the cross sections for the breakup modes largely compensate in their sum, so that the total photon absorption cross sections for ^{3}H and ^{3}He are nearly the same in both size and shape at energies near and above their peaks. Theoretical results from the literature disagree with the experimental results to a certain extent over the entire photon-energy region for which the photoneutron cross sections were measured. 50 figures, 7 tables.

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 39032

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 39085

NUCLEAR PROPERTIES AND REACTIONS, A=6-19, EXPERIMENTAL

REFER ALSO TO CITATION(S) 38493

RADIOACTIVE DECAY

REFER ALSO TO CITATION(S) 39048

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 39019

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 38964

39018 (LBL—9711, pp 96-99) **Production of neutron-rich light nuclei by fragmentation of high energy heavy-ion beams.** Symons, T.J.; Westfall, G.D.; Viyogi, Y.P. Mar 1980.

In Nuclear science. Annual report, July 1, 1978-June 30, 1979.

Fragmentation of 205-MeV/nucleon ^{48}Ca beams was studied. Fourteen new isotopes were noted. An M vs Z scatter plot is shown along with mass histograms of individual elements. Production cross sections for Na isotopes by proton spallation of ^{238}U at 28 GeV, fragmentation of ^{40}Ar on C at 8.1 GeV, and fragmentation of ^{48}Ca on Be at 9.2 GeV are compared. 3 figures. (RWR)

39019 **Atomic-excitation effects on nuclear reactions.** Thompson, W.J.; Wilkerson, J.F.; Clegg, T.B.; Feagin, J.M.; Ludwig, E.J.; Merzbacher, E. (Department of Physics and Astronomy, University of North Carolina, Chapel Hill, North Carolina 27514). *Phys. Rev. Lett.;* **45**: No. 9, 703-706(1 Sep 1980).

Atomic-excitation effects arising from sudden nuclear recoil are shown to be a significant factor in broadening the 14.23-MeV resonance in ^{13}C(p,p)^{12}C measured with a high—energy-resolution polarized beam. The total width of the resonance is found to be 1010 +- 30 eV.

39020 **New spectroscopy of heavy-ion resonances.** Erb, K.A. (Yale Univ., New Haven, CT). Contract EY-76-C-02-3074. pp 311-322 of Future directions in studies of nuclei far from stability. Hamilton, J.H.; Spejewski, E.H.; Bingham, C.R.; Zganjar, E.F. (eds.). New York, NY; North-Holland Publishing Co. (1980).

From International symposium on future directions in studies of nuclei far from stability; Nashville, TN, USA (10 Sep 1979).

Resonance phenomena observed in nucleus - nucleus interactions are reviewed, with emphasis on resonance properties revealed by experimental study. 50 references, 15 figures.

NUCLEAR PROPERTIES AND REACTIONS, A=20-38, THEORETICAL

NUCLEAR REACTIONS AND SCATTERING

39021 (DOE/ER/03992—388) **Thermodynamic interpretation of multiparticle emission in relativistic heavy ion collisions.** Gleeson, A.M.; Raha, S. (Texas Univ., Austin (USA). Center for Particle Theory). Feb 1980. Contract AS05-76ER03992. 17p. NTIS, PC A02/MF A01.

The scattering of the heavy ion Ne from NaF is analyzed at relativistic energy. The spectra of the emission fragments are studied for evidence of a thermodynamic-hydrodynamic collective motion. The spectra of pion, deuteron, and proton emission are fitted for fixed beam and target. The fit is consistent with an interpretation of an expanding hot fluid of interacting nucleons. 2 figures.

NUCLEAR PROPERTIES AND REACTIONS, A=20-38, EXPERIMENTAL

MASS, ABUNDANCE, AND BINDING ENERGY

REFER ALSO TO CITATION(S) 39014

ENERGY LEVELS AND TRANSITIONS

39022 (DOE/ER/10335—2) **Research in nuclear physics. Progress report, August 1, 1979-July 31, 1980.** Kozub, R.L. (Tennessee Technological Univ., Cookeville (USA). Dept. of Physics). 1980. Contract AS05-79ER10335. 59p. NTIS, PC A04/MF A01.

Research during the contract year is summarized. Results are shown for lifetimes of levels in ^{20}F, ^{21}F, and ^{22}Ne, along with a decay scheme for ^{52}Cr (with spin-parity assignments) and the relative yield of gamma-ray transitions vs average energy of coincident alpha particles from Li + ^{51}V reactions. Completed work will be published. 6 figures. (RWR)

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 39020, 39052, 39062

39023 (LBL—9711, pp 77-78) **Entrance angular momentum dependence of the /sup 44m,g/Sc isomer ratio in the reaction ^{29}Si(^{18}O,p2n)^{44}Sc.** Aleklett, K.; Loveland, W.; McGaughey, P.L.; Morrissey, D.J.; Seaborg, G.T. Mar 1980.

In Nuclear science. Annual report, July 1, 1978-June 30, 1979.

The isomer ratio is plotted for beam energies from 30 to 80 MeV. 1 figure. (RWR)

39024 (LBL—9711, pp 103-104) **Proton and pion spectra at large angles.** Nagamiya, S.; Anderson, L.; Bruckner, W.; Chamberlain, O.; Lemaire, M.C.; Schnetzer, S.; Shapiro, G.; Steiner, H.; Tanihata, I. Mar 1980.

In Nuclear science. Annual report, July 1, 1978-June 30, 1979.

Inclusive proton and pion spectra were measured for several combinations of projectile and target nuclei at beam energies of 400, 800, and 2100 MeV/A. Energy spectra at c.m. 90° are shown for collisions of 800 MEV/A Ne + NaF. The shape of the proton energy spectra is exponential at high energies, but deviates substantially from exponential at low energies. The shape of pion spectra, however, is exponential at all energies. Furthermore, the exponential slope for pions is steeper than that for protons. The exponential slope increases as the beam energy is increased. The pion yield also increases for higher beam energies, while the proton yield stays almost constant at all beam energies. These observations are again in reasonable agreement with the predictions of both models. The clean knock-out model (the CKO model) and the thermal model both explain the dominant features of the observed energy spectra. The angular distribution of protons in 800 MeV/A Ar + KCl is plotted in the c.m. frame. There is a sharp difference between the predictions of the two models. The data show in general forward and backward peaking, but the ratio of forward to 90° yield is not as large as the prediction of the CKO model. The thermal model should show an isotropic distribution, because there the multiple collisions are dominant, and all the initial memory of the beam direction is lost. The data certainly deviate from it, and strongly suggest that the inclusive data are a mixture of the two components, thermal and CKO processes. 2 figures. (RWR)

39025 (LBL—9711, pp 105-106) **Composite particle emission in relativistic heavy-ion collisions.** Lemaire, M.C.; Nagamiya, S.; Schnetzer, S.; Steiner, H.; Tanihata, I. Mar 1980.

In Nuclear science. Annual report, July 1, 1978-June 30, 1979.

Momentum spectra from the reaction Ar + KCl → d + X at 800 MeV/A are compared with predictions of the coalescence model. The predicted power law dependence holds very well, while the prediction of the firestreak model does not reproduce the data. 2 figures. (RWR)

39026 (LBL—9711, pp 116-120) **Total disintegration in relativistic heavy-ion interactions.** Sandoval, A.; Harris, J.W.; Geaga, J.V.; Stelzer, H.; Stock, R.; Schroeder, L.S.; Wolf, K.L. Mar 1980.

In Nuclear science. Annual report, July 1, 1978-June 30, 1979.

Total and π^- multiplicity distributions for the Ar + KCl interaction are shown for bombarding energies of 1.0 to 1.82 GeV/nucleon. The correlation between the multiplicities is shown as contours of equal probability for the highest bombarding energy. 3 figures. (RWR)

39027 (ORNL—5662) **Evaluation of cross sections for neutron-induced reactions in sodium.** Larson, D.C. (Oak Ridge National Lab., TN (USA)). Sep 1980. Contract W-7405-ENG-26. 190p. (ENDF—299). NTIS, PC A09/MF A01.

An evaluation of the neutron-induced cross sections of ^{23}Na has been done for the energy range from 10^{-5} eV to 20 MeV. All

significant cross sections are given, including differential cross sections for production of gamma rays. The recommended values are based on experimental data where available, and use results of a consistent model code analysis of available data to predict cross sections where there are no experimental data. This report describes the evaluation that was submitted to the Cross Section Evaluation Working Group (CSEWG) for consideration as a part of the Evaluated Nuclear Data File, Version V, and subsequently issued as MAT 1311. 126 references, 130 figures, 14 tables.

39028 Rotational energy and the diffuseness of the boundary between fusion and strongly damped collisions. Adler, L.; Gonthier, P.; Ho, J.H.K.; Khodai, A.; Namboodiri, M.N.; Natowitz, J.B.; Simon, S. (Cyclotron Institute, Texas A&M University, College Station, Texas 77843). *Phys. Rev. Lett.;* **45**: No. 9, 696-699(1 Sep 1980).

Differences in the kinetic energies of the fragments produced in the scission of the pairs of similar composite nuclei ^{59}Cu-^{80}Zn and ^{83}Y-^{58}Zr are interpreted as resulting from angular momentum fractionation. The energies indicate that some partial waves with angular momenta 10h to 15h below the sharp-cutoff fusion limit lead to strongly damped collisions.

NUCLEAR PROPERTIES AND REACTIONS, A=39-58, EXPERIMENTAL

MASS, ABUNDANCE, AND BINDING ENERGY

REFER ALSO TO CITATION(S) 39034

39029 (KFK—2830, pp 56-71) **Nuclear charge radii of the 1f/sub 7/2/ shell nuclei from muonic atoms.** Wohlfahrt, H.D. (Los Alamos Scientific Lab., NM (USA)). Jul 1979.

From International discussion meeting about what do we know about radial shape of nuclei in the Ca region; Karlsruhe, F.R. Germany (2 May 1979).

Muonic X-ray studies of medium-weight nuclei have been performed in recent years by the Los Alamos muonic X-ray group, using the high-intensity muon beam available at the LAMPF 800 MeV proton accelerator. These studies, which together include all stable 1f/sub 7/2/ neutron shell nuclei, provide information about the proton core polarization due to the successive addition of neutrons for the proton cores Z = 20 (Ca), 22 (Ti), 24(Cr), 26(Fe) and 28(Ni). In addition, these studies, which represent the first systematic investigations of isotone shifts, provide the opportunity to compare the core polarization caused by protons with core polarization caused by neutrons in the same (1f/sub 7/2/) shell.

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 39022, 39028, 39031

MOMENTS AND SPIN

REFER ALSO TO CITATION(S) 38968

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 38965, 39028, 39044

39030 (CONF-800979—1) **Evaluation of photon production data from neutron-induced reactions.** Fu, C.Y. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 19p. NTIS, PC A02/MF A01.

From Workshop on nuclear data evaluation methods and procedures; Upton, NY, USA (22 Sep 1980).

The evaluation methods and procedures used for generating the photon production data in the current Evaluated Nuclear Data File (ENDF/B, Version V) are reviewed. There are 42 materials in the General Purpose File of ENDF/B-V that contain data for prompt photon production. Almost all evaluations had substantial experimental data bases, but fewer than half of them employed any of the following evaluation methods. Only a few used theoretical techniques that are sophisticated enough to ensure internal consistency with other particle production data. Comments are made on four evaluation methods: the empirical formalism of Howerton et al., the Troubetzkoy model, the multiparticle Hauser-Feshbach/precompound model, and the Yost method. Critiques are also made on three procedures used for conserving photon energies in neutron capture reactions. The presence of photon production data in the file is useful for studying energy balance, since photon production generally accounts for a large portion of the reaction energy output. Problems found in energy balance checks are discussed. 9 figures, 1 table.

39031 (ORNL/TM—6405) **Evaluation of resonance parameters for neutron interaction with iron isotopes for energies up to 400 keV.** Perey, C.M.; Perey, F.G. (Oak Ridge National Lab., TN (USA)). Sep 1980. Contract W-7405-ENG-26. 80p. (ENDF—298). NTIS, PC A05/MF A01.

The evaluation of the resolved resonance parameters of iron isotopes 54, 56, and 57 in the neutron energy region below 400 keV is documented. Estimates of the uncertainties in the resonance parameters and correlation between the partial widths Γ/sub n/ and Γ/sub γ/ are given when significant. Some details about the procedures used to evaluate the resonance parameters, their uncertainties, and correlations are reported. This evaluation was performed for the general-purpose file of the Evaluated Nuclear Data File (ENDF/B-V MAT 1326). 4 figures, 7 tables.

NUCLEAR PROPERTIES AND REACTIONS, A=59-89, THEORETICAL

ENERGY LEVELS AND TRANSITIONS

39032 Shape coexistence in ^{16}O, ^{72}Se, and ^{240}Pu: a comprehensive view based on the dynamic deformation model. Kumar, K. (Centre d'Etudes de Bruyeres-le-Chatel, Montrouge, France). pp 265-280 of Future directions in studies of nuclei far from stability. Hamilton, J.H.; Spejewski, E.H.; Bingham, C.R.; Zganjar, E.F. (eds.). New York, NY; North-Holland Publishing Co. (1980).

From International symposium on future directions in studies of nuclei far from stability; Nashville, TN, USA (10 Sep 1979).

The dynamic deformation model has been improved and applied to calculate the potential energies of deformation and the collective spectra of ^{16}O, ^{72}Se, and ^{240}Pu. A comprehensive view based on the dynamics of five-dimensional quadrupole motion is provided for three seemingly different types of shape coexistence: spherical (Op - Oh) and deformed (2p - 2h) shapes in ^{16}O, spherical and deformed minima in the potential energy surface of ^{72}Se, ground-state shape and the fission-isomer shape of ^{240}Pu. 5 figures, 3 tables.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 39013

39033 (LBL—9711, pp 51-53) **Dynamical effects in the reactions of ^{20}Ne with ^{63,65}Cu and ^{197}Au.** Mathews, G.J.; Wozniak, G.J.; Moulton, J.B.; Moretto, L.G. Mar 1980.

In Nuclear science. Annual report, July 1, 1978-June 30, 1979.

Previous experimental angular distribution data near 170 MeV are compared with predictions of a unified model of the diffusive mass exchange taking place during the collision. Overall, the agreement seems quite reasonable. 2 figures. (RWR)

NUCLEAR PROPERTIES AND REACTIONS, A=59-89, EXPERIMENTAL

MASS, ABUNDANCE, AND BINDING ENERGY

39034 (INKA-Conf—79-001-000, pp 1-17) **Systematics of nuclear charge distributions in the region 40 <= A <= 100 deduced from elastic electron scattering, muonic X-ray and optical isotope shift measurements.** Wohlfahrt, H.D.; Shera, E.B.; Hoehn, M.V.; Yamazaki, Y. (Los Alamos Scientific Lab., NM (USA)); Schwentker, O.; Fricke, G.; Glueckert, S.; Mallot, G.; Andresen, H.G. (Mainz Univ. (Germany, F.R.). Inst. fuer Kernphysik); Steffen, R.M. (Purdue Univ., Lafayette, IN (USA). Dept. of Physics). 1979.

From International workshop on gross properties of nuclei and nuclear excitations; Hirschegg, Austria (27 Jan 1979).

The nuclear charge distribution and nuclear charge distribution differences have been investigated by 300 MeV elastic electron scattering. Muonic X-ray measurements yield complementary information to electron scattering results. Both experimental data are analyzed in an almost model independent way. Preliminary data from the 1f/sub 7/2/ proton and neutron shell measured at LAMPF and from the Sr-Mo region measured at SIN show the same systematic behavior as previous results in the Ni region.

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 39012

39035 In-beam γ-ray studies of ^{80}Kr. Sastry, D.L.; Ahmed, A.; Ramayya, A.V.; Piercey, R.B.; Kawakami, H.; Hamilton, J.H.; Maguire, C.F.; de Lima, A.P. (Vanderbilt Univ., Nashville, TN (USA). Dept. of Physics); Robinson, R.L.; Kim, H.J. (Oak Ridge National Lab., TN (USA)). pp 183-185 of Nuclear physics and solid state

physics. Vol. 20B. Nuclear physics. Bombay, India; Department of Atomic Energy (1978).

From Nuclear physics and solid state physics symposium; Pune, India (26 Dec 1977).

In-beam γ-ray studies of ^{80}Kr have been studied via the ^{70}Zn(^{12}C,2n)^{80}Kr reaction at 38 MeV. Gamma-gamma coincidence and angular distribution studies were carried out with two large (18%) Ge(Li) detectors. The coincidence events were stored on a magnetic disk as a 1k x 1k matrix for off-line analysis. The coincidence data were used to establish the level structure. From the analysis of angular distributions, and directional correlation from oriented nuclei, spins and parities have been assigned to many of the levels. Observations on the yrast bands and the moment of inertia plots are reported.

39036 Band crossing and quasiparticle excitations in nuclei around ^{78} ^{80}Kr. Funke, L.; Winter, G.; Doering, J.; Dubbers, F.; Kemnitz, P.; Will, E. (Zentralinstitut fuer Kernforschung, Rossendorf, Germany). Contract W-7405-ENG-48. pp 231-237 of Future directions in studies of nuclei far from stability. Hamilton, J.H.; Spejewski, E.H.; Bingham, C.R.; Zganjar, E.F. (eds.). New York, NY; North-Holland Publishing Co. (1980).

From International symposium on future directions in studies of nuclei far from stability; Nashville, TN, USA (10 Sep 1979).

The excited states in ^{80}Kr, ^{78}Kr, ^{75}Br, and ^{74}Br have been investigated by using in-beam γ-ray spectroscopy. An analysis of the excitation energies of these nuclei and some of their neighbors in the framework of the cranking model shows the influence of the qp excitations on the collective properties, such as deformation and pairing, to be very large. 5 figures.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 39028, 39030, 39035, 39044

39037 (LBL—9711, pp 67-68) **Study of γ-ray multiplicities from deep inelastic reactions induced by 7.2 and 8.5 MeV/A ^{40}Ar on ^{63}Cu and ^{159}Tb targets.** Lutolf, M.; Wozniak, G.J.; Mathews, G.J. Mar 1980.

In Nuclear science. Annual report, July 1, 1978-June 30, 1979.

Measured multiplicities are plotted as a function of Z; a dramatic dependence is observed for the ^{159}Tb target. 2 figures. (RWR)

NUCLEAR PROPERTIES AND REACTIONS, A=90-149, THEORETICAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 39058

39038 How well can we predict nuclei far from stability. Iachello, F. (Yale Univ., New Haven, CT). Contract EY-76-C-02-3074. pp 281-294 of Future directions in studies of nuclei far from stability. Hamilton, J.H.; Spejewski, E.H.; Bingham, C.R.; Zganjar, E.F. (eds.). New York, NY; North-Holland Publishing Co. (1980).

From International symposium on future directions in studies of nuclei far from stability; Nashville, TN, USA (10 Sep 1979).

The spectra of medium-mass and heavy even-even nuclei are characterized, in their low-lying part, by the occurrence of collective quadrupole states. One description of collective quadrupole states is in terms of correlated particle pairs, to which one associates algebraic boson variables s, d. The interacting neutron-proton boson model is itself first discussed. Then predictions of energy spectra, B(E2) values, and mixing ratios based on this model are shown for Xe, Ba, and Ce isotopes. Important quantities to measure and the physical idea upon which the interacting proton-neutron model is based are discussed. 15 figures. (RWR)

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 39045

NUCLEAR PROPERTIES AND REACTIONS, A=90-149, EXPERIMENTAL

MASS, ABUNDANCE, AND BINDING ENERGY

REFER ALSO TO CITATION(S) 39014, 39034

RADIOACTIVE DECAY

REFER ALSO TO CITATION(S) 39042, 39063

39039 (LBL—9711, pp 80-81) **Half-lives of neutron deficient europium isotopes.** Hogan, J.J. Mar 1980.

In Nuclear science. Annual report, July 1, 1978-June 30, 1979.

Half-lives of ^{145}Eu, ^{146}Eu, ^{147}Eu, and ^{148}Eu are tabulated, along with experimental errors. 1 table. (RWR)

39040 Atomic masses for nuclides far from stability. Wapstra, A.H. (Amsterdam Univ. of Technology, Delft, Netherlands). pp 209-219 of Future directions in studies of nuclei far from stability. Hamilton, J.H.; Spejewski, E.H.; Bingham, C.R.; Zganjar, E.F. (eds.). New York, NY; North-Holland Publishing Co. (1980).

From International symposium on future directions in studies of nuclei far from stability; Nashville, TN, USA (10 Sep 1979).

New alpha decay energies have been measured for very neutron-deficient nuclides with A = 105 to 115 and 145 to 170. Some of these alpha chains are connected to the system of known masses by new reaction energies. An important set of new beta decay energies has become available for neutron-rich nuclides with A = 90 to 100 and 140 to 150. These and other data are here compared with one another and especially with the very important new on-line mass determinations for Rb and Cs isotopes far from stability. 10 figures, 1 table.

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 39054

39041 (LBL—9711, pp 74-75) **Decay of the complete fusion nucleus, ^{151}Eu.** Hogan, J.J. Mar 1980.

In Nuclear science. Annual report, July 1, 1978-June 30, 1979.

The ^{133}Cs(^{18}O, xr) reaction with x = 3 to 6 was studied at laboratory incident energies of 75 to 125 MeV. Measured cross sections are presented and discussed. 1 table. (RWR)

39042 Nuclear data sheets for A=106. Harmatz, B. (Oak Ridge Laboratory, Oak Ridge, Tennessee 37830). W-7405-ENG-26. *Nucl. Data Sheets;* **30**: No. 3, 305-412(Jul 1980).

Nuclear structure information pertaining to A=106 has been reviewed. The level properties obtained from decay and reaction experiments are shown in the drawings. Experimental methods, references, and comments are given in the text.

39043 In-beam nuclear structure studies in the A ~ 100 region. Fenyes, T. (Inst. of Nuclear Research, Debrecen, Hungary). pp 89-95 of Future directions in studies of nuclei far from stability. Hamilton, J.H.; Spejewski, E.H.; Bingham, C.R.; Zganjar, E.F. (eds.). New York, NY; North-Holland Publishing Co. (1980).

From International symposium on future directions in studies of nuclei far from stability; Nashville, TN, USA (10 Sep 1979).

A short survey is given about the work performed by the Nuclear Spectroscopy Research Group of the Institute in the last few years. The nuclei under investigation ($^{97\ 98\ 100}$Tc and $^{94\ 96}$Nb) were produced via (p,n) reactions from enriched targets. The γ-, γγ-coincidence, and conversion electron spectra of the reactions were taken with Ge(Li), thin-window hyperpure Ge, and super-conducting magnet transporter Si(Li) spectrometers. The energies and the intensities of the observed radiations as well as the excitation functions of the reactions were measured. Level schemes; multipolarities of transitions; and energies, spins, and parities of nuclear levels have been deduced. The level schemes have been compared with the results of recent shell model calculations. 5 figures, 1 table.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 39043, 39063

39044 (CONF-800863—1) **Giant multipole resonances: perspectives after ten years.** Bertrand, F.E. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 25p. NTIS, PC A02/MF A01.

From International conference on nuclear physics; Berkeley, CA, USA (24 Aug 1980).

Nearly ten years ago evidence was published for the first of the so-called giant multipole resonances, the giant quadrupole resonance. During the ensuing years research in this field has spread to many nuclear physics laboratories throughout the world. The present status of electric giant multipole resonances is reviewed. 24 figures, 1 table.

39045 (LA-UR—80-2674) **Calculational methods used to obtain evaluated data above 3 MeV.** Arthur, E.D. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 38p. (CONF-800979—3). NTIS, PC A03/MF A01.

From Workshop on nuclear data evaluation methods and procedures; Upton, NY, USA (22 Sep '980).

Calculational methods used to provide evaluated neutron data for nuclei between A = 19 and 220 at incident energies above several MeV range from empirical techniques based on cross-section

systematics to sophisticated nuclear-model codes that describe the major mechanisms governing neutron reactions in this mass and energy range. Examples of empirical approaches are given along with discussion concerning regions of applicability and accuracies that can be expected. The application of more sophisticated nuclear models (Hauser-Feshbach statistical, preequilibrium, and direct-reaction theories) is discussed, particularly with regard to improved parameter determinations that can be used in such calculations. Efforts to improve the consistency and to unify these theoretical approaches are addressed along with benefits to evaluated data that can be realized through careful application of such nuclear-model techniques. 76 references, 13 figures, 3 tables.

39046 (LBL—9711, pp 62-63) **Excitation functions for 40-140 MeV alpha particles incident on niobium.** Hogan, J.J.; Jacak, B.V. Mar 1980.

In Nuclear science. Annual report, July 1, 1978-June 30, 1979.

Cross sections for reactions leading to 45 isotopes and isomers with A = 82 to 96 are tabulated. 1 table. (RWR)

39047 **Some aspects of the use of deep inelastic transfer reactions to produce nuclei far from stability and nuclei with large angular momenta.** Volkov, V.V. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 221-230 of Future directions in studies of nuclei far from stability. Hamilton, J.H.; Spejewski, E.H.; Bingham, C.R.; Zganjar, E.F. (eds.). New York, NY; North-Holland Publishing Co. (1980).

From International symposium on future directions in studies of nuclei far from stability; Nashville, TN, USA (10 Sep 1979).

Some experimental data are considered that indicate the validity of the Q/sub gg/ systematics of cross sections for production of isotopes in multinucleon transfer reactions for any target-projectile combination. The effect of the nuclear structure of the light fragment on the evolution and disintegration of the double nuclear system formed in deep inelastic collisions of complex nuclei is discussed. Predominance of the α-particle emission over all other channels of the disintegration of the double nuclear system is demonstrated. It is shown that deep inelastic transfer reactions can be used to study the deformation of nuclei with large angular momenta. 9 figures.

39048 **On-line experiments with high-energy protons: recent results and possible future directions.** Hasen, P.G. (Aarhus Univ., Denmark). pp 405-417 of Future directions in studies of nuclei far from stability. Hamilton, J.H.; Spejewski, E.H.; Bingham, C.R.; Zganjar, E.F. (eds.). New York, NY; North-Holland Publishing Co. (1980).

From International symposium on future directions in studies of nuclei far from stability; Nashville, TN, USA (10 Sep 1979).

Following a brief overview of the research program at ISOLDE, a few new results are discussed in detail. These include the first observation of a new radioactive decay mode: beta-delayed two-neutron emission. Non-nuclear experiments are believed to be of increasing importance; as an example of these, experiments on shifts in the energies of K x-rays are reviewed. 8 figures, 3 tables.

NUCLEAR PROPERTIES AND REACTIONS, A=150-189, THEORETICAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 39058

39049 **Interpretation of the fragmentation of Nilsson strength amongst high-lying states in the Hf-Os region.** Casten, R.F. (Brookhaven National Lab., Upton, NY (USA)); Warner, D.D. (Institut Max von Laue - Paul Langevin, 38 - Grenoble (France)); Cizewski, J.A. (State Univ. of New York, Stony Brook (USA); Brookhaven National Lab., Upton, NY . *Nucl. Phys., A;* 333: No. 2, 237-252(14 Jan 1980).

It is shown that the significantly varying trends and some of the fine structure in the fragmentation of Nilsson strength among the high-lying states in the odd-neutron nuclei near the end of the rare earth deformed region can be qualitatively explained as a natural outcome of rapidly varying quadrupole and hexadecapole deformations. While details of individual states can emerge only from calculations incorporating more degrees of freedom, an understanding of the gross behavior of ensembles of states in this neglected region of excitation thus appears possible in an unexpectedly simple way.

NUCLEAR PROPERTIES AND REACTIONS, A=150-189, EXPERIMENTAL

RADIOACTIVE DECAY

REFER ALSO TO CITATION(S) 39040

39050 **Recent experiments at the GSI on-line separator.** Roeckl, E. (GSI Darmstadt, Germany). pp 397-404 of Future directions in studies of nuclei far from stability. Hamilton, J.H.; Spejewski, E.H.; Bingham, C.R.; Zganjar, E.F. (eds.). New York, NY; North-Holland Publishing Co. (1980).

From International symposium on future directions in studies of nuclei far from stability; Nashville, TN, USA (10 Sep 1979).

A review is given of recent experiments at the GSI on-line separator. Heavy-ion-induced fusion reactions and the structure of nuclides far from beta stability are studied in the regions of tin and lead isotopes. The status of the various investigations is described together with possible extensions and improvements. 5 figures.

ENERGY LEVELS AND TRANSITIONS

39051 (BNL—28226) **Recent experiments at Brookhaven: level structure of N = 86 isotones ^{156}Yb and ^{150}Gd.** Sunyar, A.W. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 14p. (CONF-8006119—1). NTIS, PC A02/MF A01.

From Nobel symposium 50 nuclei at very high spin-sven gosta nilsson in memoriam; Orenas, Sweden (23 Jun 1980).

States of the N = 86 isotones ^{156}Yb and ^{150}Gd have been studied by means of the ^{144}Sm(^{16}O,4n)^{156}Yb, ^{113}In(^{46}Ti,p2n)^{156}Yb, and ^{124}Sn(^{30}Si,4n)^{150}Gd reactions. Levels have been established to spin 36 h-bar and over 12.5 MeV in excitation in ^{150}Gd and to beyond spin 25 h-bar in ^{156}Yb. The systematics of levels in the N = 86 isotones from ^{150}Gd to ^{156}Yb are described, and the near-spherical shell model description for states in this region to near spin 30 h-bar is discussed. A T/sub 1/2/ = 6 ns, 72-keV isomeric transition in ^{156}Yb has been discovered, and an E1 multipolarity is assigned to this transition. The spin-parity of the isomeric state is established as 11^-. 6 figures.

39052 (LBL—9711, pp 16-18) **Measurements of lifetimes and feeding times for high spin states in ^{156}Dy.** Ward, D. (Atomic Energy of Canada Ltd., Chalk River, Ontario); Andrews, H.R.; Hausser, O.; Masri, Y.E.; Aleonard, M.M.; Lee, I.Y.; Diamond, R.M.; Stephens, F.S.; Butler, P.A. Mar 1980.

In Nuclear science. Annual report, July 1, 1978-June 30, 1979.

A 595-MeV ^{136}Xe beam was used to bombard a ^{24}Mg target. Typical coincidence gamma spectra are shown, along with decay curves for the sequence $20^+ \rightarrow 18^+ \rightarrow 16^+ \rightarrow 14^+$ in the ground-state band. It was found that centrifugal stretching in the ground band limited at, or below, spin 12, at which point the Q_0 value was comparable to that of the ground state in well-deformed neighboring nuclei. 3 figures. (RWR)

39053 (LBL—9711, pp 18-21) **Reduced transition probabilities and energies of high-spin states in ^{162}Dy.** Guidry, M.W. (Univ. of Tennessee, Knoxville); Lee, I.Y.; Johnson, N.R.; Butler, P.A.; Cline, D.; Colombani, P.; Diamond, R.M.; Stephens, F.S. Mar 1980.

In Nuclear science. Annual report, July 1, 1978-June 30, 1979.

^{162}Dy targets were bombarded by ^{136}Xe at 547 and 612 MeV. Doppler-broadened lineshapes and particle-γ coincidence spectra are shown. Energies, mean lives, and reduced transition probabilities for the ground-state rotational band are shown. B(E2) values and transition energies are compared with those for a pure rotor for several well-deformed nuclei. It is concluded that the rotational model correctly predicts transition probabilities for well-deformed nuclei. Changes in the moment of inertia seem to be due to Coriolis reduction of pairing correlations, not changes in nuclear shape. 3 figures, 1 table. (RWR)

39054 **Effects of shells and deformations from systematic studies of gamma-ray transition rates.** Andrejtscheff, W. (Inst. of Nuclear Research and Nuclear Energy, Sofia, Bulgaria). pp 115-120 of Future directions in studies of nuclei far from stability. Hamilton, J.H.; Spejewski, E.H.; Bingham, C.R.; Zganjar, E.F. (eds.). New York, NY; North-Holland Publishing Co. (1980).

From International symposium on future directions in studies of nuclei far from stability; Nashville, TN, USA (10 Sep 1979).

Conclusions from systematic considerations of γ-ray transition rates are presented. Some E1 and E2 transitions in the $A \approx 150$ region, 1-forbidden M1 transitions, and B(E2) values in the yrast bands of even-even nuclei are considered. Nanosecond time analysis with Ge(Li) detectors is briefly discussed. 4 figures.

39055 **Recent results obtained very far from stability at ISOLDE: neutron deficient odd-A iridium nuclei and triaxiality.** Schueck, C. (Centre de Spectrometrie Nucleaire et de Spectrometrie de Masse, Orsay, France); Knipper, A.; Richard-Serre, C.; Berg, V.; Zerrouki, A.; Genevey-Rivier, J. pp 127-132 of Future directions in studies of nuclei far from stability. Hamilton, J.H.; Spejewski, E.H.; Bingham, C.R.; Zganjar, E.F. (eds.). New York, NY; North-Holland Publishing Co. (1980).

From International symposium on future directions in studies of nuclei far from stability; Nashville, TN, USA (10 Sep 1979).

After a brief sketch of on-line beta-gamma spectrometry apparatus and results obtained in the period 1977-1979, data are

presented on the systematics of energy levels in the odd Ir nuclei. 5 figures. (RWR)

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 39037, 39053

39056 (LBL—9711, pp 58-59) **Fusion and emission of ^{1}H and ^{4}He in reactions between complex nuclei at high energies.** Delagrange, H. (State Univ. of New York, Stony Brook); Logan, D.; Rivet, M.R.; Rajagopalan, M.; Alexander, J.; Zisman, M.S.; Kaplan, M.; Ball, J.W. Mar 1980.

In Nuclear science. Annual report, July 1, 1978-June 30, 1979.

Angular distributions for ^{1}H, ^{4}He, and fission-like events are shown for the reaction ^{40}Ar + ^{164}Dy at 222 and 274 MeV. In addition, integrated cross sections are shown for fusion, fission, ^{1}H, ^{4}He, and evaporation residues as a function of the charge of the composite nucleus for several targets at 100 and 140 MeV excitation. The data indicate that models assuming that complete fusion occurs prior to significant loss of energy or angular momentum from the composite system are incorrect. 2 figures. (RWR)

NUCLEAR PROPERTIES AND REACTIONS, A=190-219, THEORETICAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 39091

39057 **Spectroscopic trends of very neutron-deficient nuclei in the lead region.** Frauendorf, S. (Central Inst. for Nuclear Research, Rossendorf, Germany); May, F.R.; Pashkevich, V.V. pp 133-149 of Future directions in studies of nuclei far from stability. Hamilton, J.H.; Spejewski, E.H.; Bingham, C.R.; Zganjar, E.F. (eds.). New York, NY; North-Holland Publishing Co. (1980).

From International symposium on future directions in studies of nuclei far from stability; Nashville, TN, USA (10 Sep 1979).

The shape of nuclides in the region is discussed in terms of potential energy surfaces (PES) calculated by means of the shell correction approach. The PES show several minima leading to the coexistence of different shapes. Consequences for spectra, E2 transitions, and mean square radii are discussed and compared with experimental results for Z = 80,79,78 nuclides. Quasi-particle spectra of deformed rotating nuclei calculated in the frame of the cranking model are used to analyze the experimental yrast spectra of Z = 75 to 79 nuclides. Predictive calculations for larger Z are presented. 14 figures.

39058 **Systematic study of potential energy surfaces.** Hess, P.O.; Maruhn, J.A.; Greiner, W. (Frankfurt Univ., Germany). pp 151-176 of Future directions in studies of nuclei far from stability. Hamilton, J.H.; Spejewski, E.H.; Bingham, C.R.; Zganjar, E.F. (eds.). New York, NY; North-Holland Publishing Co. (1980).

From International symposium on future directions in studies of nuclei far from stability; Nashville, TN, USA (10 Sep 1979).

Recent developments in the unified collective model are presented. After a discussion of the model Hamiltonian and the methods used to extract potential energy surfaces from the low-energy spectra, B(E2) values, and quadrupole moments of even-even nuclei, specific results for the isotopes $^{102-108}$Ru are shown. Then recent generalizations in the model Hamiltonian itself and an application to the isotopes $^{184-192}$Os, $^{186-196}$Pt, $^{180-186}$W, and ^{238}U are examined. Finally, an extension of the model to describe magnetic properties of even-even nuclei is discussed. 20 figures, 5 tables.

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 39033

NUCLEAR PROPERTIES AND REACTIONS, A=190-219, EXPERIMENTAL

MASS, ABUNDANCE, AND BINDING ENERGY

REFER ALSO TO CITATION(S) 39014

RADIOACTIVE DECAY

REFER ALSO TO CITATION(S) 39050

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 39055

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 39044, 39076

39059 (LBL—9711, pp 56-57) **Angular momentum transfer in deeply-inelastic scattering of ^{56}Fe + ^{209}Bi.** Zisman, M.S. (Univ. of Washington, Seattle); Puigh, R.J.; Vandenbosch, R.; Thomas, T.D.; Nunnelley, L. Mar 1980.

In Nuclear science. Annual report, July 1, 1978-June 30, 1979.

Angular correlations in and out of the plane were measured for 476-MeV ^{56}Fe on ^{209}Bi. Transferred angular momentum (TAM) is tabulated for various Q-value bins. TAM is also plotted as a function of incident angular momentum; its magnitude is between estimates for rolling and sticking. TAM is strongly aligned along the normal to the reaction plane. 3 figures, 1 table.

39060 (LBL—9711, pp 84-85) **Correlations between slow and fast fragments in relativistic nuclear collisions.** Meyer, W.G.; Gutbrod, H.H.; Lukner, Ch.; Sandoval, A. Mar 1980.

In Nuclear science. Annual report, July 1, 1978-June 30, 1979.

Laboratory kinetic energy spectra for Z = 6 fragments from the interaction of ^{4}He + Au at 1050 and 2100 MeV/nucleon are shown, along with mean associated charged-particle multiplicities as a function of the Z of the trigger particle. Energy dependence of the spectra and Z dependence of the multiplicity pattern are discussed. 3 figures. (RWR)

39061 (LBL—9711, pp 87-89) **Au and Tl residues from peripheral interactions of 8.0 GeV ^{20}Ne with ^{209}Bi.** Aleklett, K.; Morrissey, D.J.; Loveland, W.; Moody, K.; Seaborg, G.T. Mar 1980.

In Nuclear science. Annual report, July 1, 1978-June 30, 1979.

Target residue isotope distributions for Au and Tl isotopes were measured radioanalytically for the reaction of 8.0-GeV ^{20}Ne ions with ^{209}Bi. The isotopic production cross section for Au and Tl isotopes was also calculated with the aid of a macroscopic abrasion-ablation model and a microscopic intranuclear cascade-evaporation model. The importance of the neutron skin in determining the yield of these products from the peripheral interactions was also explored in the framework of the macroscopic model. 3 figures.

39062 (LBL—9711, pp 107-108) **Single and multiple collision components studied from inclusive and high-multiplicity events in 800 MeV/A Ar on KCl and Pb.** Nagamiya, S.; Lemaire, M.C.; Schnetzer, S.; Steiner, H.; Tanihata, I. Mar 1980.

In Nuclear science. Annual report, July 1, 1978-June 30, 1979.

Proton spectra for the Pb target and angular distributions for both targets are shown. The kinetics of the reaction is shown. The clean knock-out component for high-energy protons is very small at 90°, but dominant at small angles. 2 figures. (RWR)

39063 **Study of neutron deficient isotopes of Fr and I by means of He-jet technique.** Xi-jun, S.; Jun-sheng, G.; Zhi-zheng, Z.; Zong-you, P.; Ying-xiang, G. (Inst. of Modern Physics, Lanchow, China). pp 109-113 of Future directions in studies of nuclei far from stability. Hamilton, J.H.; Spejewski, E.H.; Bingham, C.R.; Zganjar, E.F. (eds.). New York, NY; North-Holland Publishing Co. (1980).

From International symposium on future directions in studies of nuclei far from stability; Nashville, TN, USA (10 Sep 1979).

Excitation functions for Fr isotopes produced by bombardment of ^{12}C on ^{209}Bi and the production of neutron deficient isotopes ^{118}I, ^{117}I and ^{115}I by ^{12}C on natural silver are presented. Two He-jet systems are described. Decay of three γ rays are plotted.

39064 (DOE/ER/00007—907) **Determination of the asymptotic ratio of the deuteron D- and S-state amplitudes.** Stephenson, K.; Haeberli, W. (Wisconsin Univ., Madison (USA)). [nd]. Contract AC02-76ER00007. 17p. NTIS, PC A02/MF A01.

The value 0.02649 +- 0.00043 is deduced for the deuteron asymptotic D- to S-state ratio from measurements of the ^{208}Pb(d,p)^{209}Pb tensor analyzing powers at sub-Coulomb bombarding energies E/sub d/ = 7, 8, and 9 MeV. The quoted uncertainty includes statistical errors, beam polarization measurement errors, and systematic errors that result from a choice of optical model parameters used to describe the reaction. The result is compared to several theoretical deutron wave functions. 2 figures, 1 table.

SPONTANEOUS AND INDUCED FISSION

39065 (LBL—9711, pp 60-61) **Rapid energy equilibration and emission for H and He in the reaction 340 MeV ^{40}Ar + ^{197}Au.** Logan, D. (Carnegie-Mellon Univ., Pittsburgh, PA); Rajagopalan, M.; Zisman, M.S.; Alexander, J.M.; Kaplan, M.; Kowalski, L. Mar 1980.

In Nuclear science. Annual report, July 1, 1978-June 30, 1979.

Angular and energy distributions for H/He detected in coincidence with heavy fragments are shown. It is concluded that the major fraction of the H/He recorded in singles is emitted in coincidence with a heavy fragment. It is found that the major mechanism responsible for H/He emission involves fission-like reactions rather

than quasi-elastic or deeply inelastic reactions, and that H/He emission occurs even before the act of scission. 3 figures. (RWR)

NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, THEORETICAL

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 39032, 39058

NUCLEAR REACTIONS AND SCATTERING

39066 (KFK—2907) **Use of optical model to evaluate fast neutron cross-sections for transactinide nuclei.** Fischer, U. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik). Feb 1980. 66p. NTIS (US Sales Only), PC A04/MF A01.

Work performed under United States-W. Germany Fast Reactor Exchange Program.

With the aim to evaluate optical model cross sections, the optical model formalism is described. A sensitivity analysis is performed by adjustment of the optical model parameters. Optical model cross sections for a spherical potential are evaluated for the nuclei ^{238}U, ^{240}Pu, ^{242}Pu, ^{241}Am, and ^{244}Cm; the smooth A-dependence of these cross sections was taken into account. With the compound elastic cross section computed by means of the Hauser/Feshbach formula, and in one case by a semi-empirical method, the following types of cross section are obtained: the total cross section, the elastic cross section σ/sub el/, the reaction cross section, and the differential elastic cross section d σ/sub el//dΩ. The evaluated cross sections are compared with experimental data. Discrepancies in experimental and evaluated data are pointed out, and recommendations are given. Furthermore, capture cross sections are evaluated on the basis of the simple giant dipole resonance model. 20 figures.

NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, EXPERIMENTAL

MASS, ABUNDANCE, AND BINDING ENERGY

REFER ALSO TO CITATION(S) 39076

39067 (CONF-800766—2) **Study of the fission isomer /sup 240m/Am (S.F.) using laser-induced nuclear polarization.** Beene, J.R.; Bemis, C.E. Jr.; Young, J.P.; Kramer, S.D. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 5p. NTIS, PC A02/MF A01.

From 5. international conference on hyperfine interactions; Berlin, F.R. Germany (21 Jul 1980).

The optical isomer shift was measured for the spontaneously fissioning isomer /sup 240m/Am. This shift is approximately 27 times greater than the ^{241}Am-^{243}Am isotope shift, and confirms the conventional identification of fission isomers with large deformation. The measured isomer shift is consistent with a nuclear quadrupole moment of 30.4 b, in agreement with theoretical expectations. 2 figures. (RWR)

RADIOACTIVE DECAY

REFER ALSO TO CITATION(S) 39050, 39074

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 39012, 39069, 39070, 39071

MOMENTS AND SPIN

REFER ALSO TO CITATION(S) 39067

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 39067

39068 (BNL-NCS—51184) **Evaluation of ^{235}U neutron cross section and gamma ray production data for ENDF/B-V.** Bhat, M.R. (Brookhaven National Lab., Upton, NY (USA)). Mar 1980. Contract AC02-76CH00016. 71p. (ENDF—248). NTIS, PC A04/MF A01.

A discussion is given of the evaluation of neutron and gamma ray production cross sections of ^{235}U from 10^{-5} eV to 20 MeV and the parts contributed by the author. All available new data are included in this evaluation, and the procedures adopted to assess the experimental data and adopt a set of recommended values are described. 22 figures, 10 tables.

39069 (CONF-800942—8) **Precise measurement and analysis of neutron transmission through ^{232}Th.** Olsen, D.K.; Ingle, R.W.; Portney, J.L. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 12p. NTIS, PC A02/MF A01.

From ANS topical meeting on 1980 advances in reactor physics and shielding; Sun Valley, ID, USA (14 Sep 1980).

Three sets of transmission time spectra through up to eight samples of ^{232}Th have been measured for neutron energies from 6.0 MeV to 0.1 MeV by use of a flight-time technique over 22- and 40-m path lengths, the ORELA pulsed neutron source, and a 1-mm-thick lithium glass detector. The resulting total cross section from 0.1 to 20.0 eV seems to be smaller than that contained in the ENDF/B-V evaluation. Least-squares analysis of the transmissions from 9 to 440 eV using a multilevel Breit-Wigner formalism results in neutron widths consistent with those previously reported. An average radiation width of 25.2 MeV is obtained for 19 low-energy s-wave resonances. 3 figures, 5 tables.

39070 (LA-UR—80-2675) **Intermediate structure in unresolved resonances of fissile and fertile nuclides.** Moore, M.S. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 13p. (CONF-800942—11). NTIS, PC A02/MF A01.

From ANS topical meeting on 1980 advances in reactor physics and shielding; Sun Valley, ID, USA (14 Sep 1980).

Evidence for the existence of intermediate structure in the unresolved resonance fission and capture cross sections of ^{235}U and in the capture cross section of ^{238}U is reviewed. Certain of the statistical tests that have been used are known to be compromised by finite resolution when applied to unresolved resonance data, but it is concluded that over most of the energy range the test results are valid. Parity assignments for the structure in ^{238}U(n, γ) suggest that s-wave neutron absorption is responsible for much of the structure. If this is the case, the cross section fluctuations are most likely due to fluctuations in the radiative capture width, rather than in the neutron width. Finally, the practical effect of the possible presence of width correlations in fertile and fissile nuclides is addressed. 1 figure, 1 table.

39071 (LBL—9711, pp 3-7) **Observation of isoscalar giant resonance structure in the fission of ^{238}U following inelastic scattering of ^{6}Li.** Shotter, A.C.; Gelbke, C.K.; Awes, T.C.; Back, B.; Mahoney, J.; Symons, T.J.M.; Scott, D.K. Mar 1980.

In Nuclear science. Annual report, July 1, 1978-June 30, 1979.

A typical singles ^{6}Li spectrum is shown along with a number of energy spectra of inelastically scattered ^{6}Li observed in coincidence for various detector geometries. Fission probabilities are shown as a function of excitation energy; the error is 50%. 3 figures. (RWR)

39072 (LBL—9711, pp 63-66) **New spontaneous fission activities produced in bombardments ^{16}O + ^{248}Cm, ^{18}O + ^{248}Cm, ^{15}N + ^{249}Bk, ^{18}O + ^{249}Bk, and ^{13}C + ^{249}Bk.** Nitschke, J.M.; Somerville, L.P.; Nurmia, M.J.; Ghiorso, A. Mar 1980.

In Nuclear science. Annual report, July 1, 1978-June 30, 1979.

Several reactions were investigated with a view toward producing ^{260}104 with a proposed half-life of 80 to 300 ms; results were negative. Upper limits for cross sections are given. Excitation functions for the reaction ^{18}O + ^{248}Cm are presented from 80 to 120 MeV. Cross sections for various cross bombardments producing activities of 19 ms, 54 ms, and 1.4 s are tabulated. 1 figure, 2 tables. (RWR)

39073 (LBL—9711, pp 73-74) **Radiochemical study of actinide elements produced in the interaction of ^{136}Xe with ^{244}Pu.** Lee, D.; Hoffman, D.C.; Hogan, J.J.; Jacak, B.V.; Jae, W.M.; Nurmia, M.; Thomas, K.E.; Seaborg, G.T. Mar 1980.

In Nuclear science. Annual report, July 1, 1978-June 30, 1979.

The experimental procedure is described, and cross sections for production of actinides from ^{237}U to ^{257}Fm at approx. 955 MeV are tabulated. 1 table. (RWR)

39074 (LBL—9711, pp 76-77) **Yields of Bk isotopes from ^{249}Bk plus ^{18}O.** McFarland, R.M. Mar 1980.

In Nuclear science. Annual report, July 1, 1978-June 30, 1979.

The yields of berkelium isotopes from reactions at 93.4 and 98.5 MeV are tabulated. The separations chemistry employed is described. 1 table. (RWR)

39075 (LBL—9711, pp 115-116) **Energy dissipation in relativistic nuclear collisions.** Gutbrod, H.H.; Meyer, W.G.; Poskanzer, A.M. Mar 1980.

In Nuclear science. Annual report, July 1, 1978-June 30, 1979.

Uranium was bombarded with p, ^{4}He, ^{20}Ne, and ^{40}Ar at energies from 250 MeV/nucl to 2.1 GeV/nucl. The associated multiplicity for protons of 40 to 200 MeV is plotted vs total kinetic energy; a nearly linear relation is noted. The observed multiplicity distributions for ^{20}Ne and ^{40}Ar projectiles are nearly the same. The results support models in which a high density is reached in the

diving stage; then, in the expansion phase, the energy is spread over most of the nucleus. 2 figures. (RWR)

39076 Some new approaches to the synthesis of heavy and superheavy elements. Flerov, G.N. (Joint Institute for Nuclear Research, Dubna, USSR). pp 339-352 of Future directions in studies of nuclei far from stability. Hamilton, J.H.; Spejewski, E.H.; Bingham, C.R.; Zganjar, E.F. (eds.). New York, NY; North-Holland Publishing Co. (1980).

From International symposium on future directions in studies of nuclei far from stability; Nashville, TN, USA (10 Sep 1979).

Work on the synthesis of heavy and superheavy elements is discussed. It is shown that the new regularity of the systematics of spontaneous-fission half-lives, established for heavy nuclei at Dubna, has made it possible to extend the region of the nuclei being synthesized. In particular, it becomes possible to produce relatively long-lived heavy isotopes of $Z \geqq 107$. The results of experiments to study the emission of energetic α particles in the collision of heavy nuclei are presented. It is noted that such reactions can be used to produce atomic nuclei with low excitation energy and large angular momentum. The possible use of similar reactions in the synthesis of heavy and superheavy elements is discussed. In case the existence of a naturally occuring superheavy element has been established, a possibility will arise to synthesize in nuclear reactions a number of isotopes belonging to the island of stability, and to investigate their properties. The present state of work on the search for superheavy elements in nature is briefly described. 8 figures.

SPONTANEOUS AND INDUCED FISSION

REFER ALSO TO CITATION(S) 39067, 39068, 39071, 39072, 39076

39077 (HEDL-SA—2205) **Evaluation of fission product yields for the US national nuclear data files.** Rider, B.F.; England, T.R.; Madland, D.G.; Liaw, J.R.; Schenter, R.E. (General Electric Co., San Jose, CA (USA); Los Alamos Scientific Lab., NM (USA); Argonne National Lab., IL (USA); Hanford Engineering Development Lab., Richland, WA (USA)). Sep 1980. Contract AC14-76FF02170. 31p. NTIS, PC A02/MF A01.

Accurate knowledge of fission product decay heat is an important input to the design of quality emergency core cooling systems for nuclear power plants. The General Electric Company has prepared an evaluated set of fission product yields for use in calculation of decay heat curves with improved accuracy. These evaluated yields are based on all known experimental data through mid-1980. Unmeasured fission product yields are calculated from charge distribution, pairing effects, and isomeric state models developed at Los Alamos Scientific Laboratory. Numerous tests of the data have been made at General Electric, Los Alamos Scientific Laboratory, Hanford Engineering Development Laboratory, and the Argonne National Laboratory before incorporating them into Version V of the Evaluated Nuclear Data File (ENDF/B-V). The 1980 version incorporates $\sim$ 88,000 yields and their uncertainties in 40 sets of $\sim$ 1100 values for independent yields before delayed neutron (DN) emission by 102 precursors, and a like number of cumulative yields after DN emission. The sets include 27 fissionable nuclides at one or more neutron fission energies. The models used, data sources, evaluation methods, the integral tests made, and the role of accurate fission product yields in reactor design are discussed. The 1980 yields are available as ENDF-292 (1980) from the National Nuclear Data Center at Brookhaven National Laboratory, Upton, N.Y., B.F. Rider, General Electric Company, Vallecitos Nuclear Center, P.O. Box 460, Pleasanton, CA 94566. 6 figures, 8 tables.

39078 (LBL—9711, pp 25-29) **Spontaneous fission properties of the neutron-deficient Fm isotopes, 1.2-s ^{246}Fm and 38-s ^{248}Fm.** Hoffman, D.C.; Lee, D.; Ghiorso, A.; Nurmia, M.J.; Aleklett, K. Mar 1980.

In Nuclear science. Annual report, July 1, 1978-June 30, 1979.

Fm isotopes were produced by ^{239}Pu(^{12}C, 5n) and ^{239}Pu(^{13}C, 4n) reactions. Half-lives were determined for spontaneous fission of ^{246}Fm and ^{248}Fm. Pre-neutron-emission kinetic energy and mass distributions of fragments are shown. Properties of the energy distribution are tabulated. 2 figures. 1 table. (RWR)

39079 (LBL—9711, pp 71-72) **Fission following transfer to ^{232}Th at energies below the Coulomb barrier.** Leigh, J.R.; Diamond, R.M.; Johnston, A.; Newton, J.O.; Sie, S.H. Mar 1980.

In Nuclear science. Annual report, July 1, 1978-June 30, 1979.

50-μg/cm^2 ^{232}Th targets were bombarded by beams of ^{16}O and ^{19}F at 75 to 95 and 85 to 95 MeV, respectively. Dominant reactions leading to fission are nucleon and α stripping. The measured excitation functions are plotted and discussed. 2 figures. (RWR)

39080 (LBL—9711, pp 92-93) **Target residue production in the reaction of 8.0 GeV neon with uranium.** McGaughey, P.L.; Morrissey, D.J.; Loveland, W.; Seaborg, G.T. Mar 1980.

In Nuclear science. Annual report, July 1, 1978-June 30, 1979.

Based on the observed product abundances, independent yield formation cross sections are given as a function of most probable atomic number for products with Z = 51 to 57. Mass yield cross sections are also shown. 3 figures. (RWR)

39081 (LBL—9711, pp 94-95) **Radiochemical determination of target residues produced by the reaction of 28 GeV protons with uranium.** Jacak, B.V.; Morrissey, D.J.; Rodder, M.; Seaborg, G.T. Mar 1980.

In Nuclear science. Annual report, July 1, 1978-June 30, 1979.

Mass yields in the region A = 180 to 200 were observed. The kinetics of the p + U reaction at these energies is discussed. 1 figure. (RWR)

NUCLEAR THEORY

39082 (SLAC-PUB—2595) **Synthesis of quantum chromodynamics and nuclear physics.** Brodsky, S.J.; Lepage, G.P. (Stanford Linear Accelerator Center, CA (USA); Cornell Univ., Ithaca, NY (USA). Lab. of Nuclear Science). Aug 1980. Contract AC03-76SF00515. 10p. (CONF-800829—8). NTIS, PC A02/MF A01.

From International conference on the few body problems; Eugene, OR, USA (17 Aug 1980).

The asymptotic freedom behavior of quantum chromodynamics allows the rigorous calculation of hadronic and nuclear amplitudes at short distances by perturbative methods. The implications of QCD for large-momentum-transfer nuclear form factors and scattering processes, as well as for the structure of nuclear wave functions and nuclear interactions at short distances, are discussed. The necessity for color-polarized internal nuclear states is also discussed. 6 figures.

NUCLEAR STRUCTURE

39083 (BNL—28357) **Problem of phase transitions in nuclear structure.** Scharff-Goldhaber, G. (Brookhaven National Lab., Upton, NY (USA); Cornell Univ., Ithaca, NY (USA)). 1980. Contract AC02-76CH00016. 9p. (CONF-8006127—1). NTIS, PC A02/MF A01.

From International conference on interacting bose-fermi systems in nuclei; Erice, Sicily, Italy (12 Jun 1980).

Phase transitions between rotational and vibrational nuclei are discussed from the point of view of the variable moment of inertia model. A three-dimensional plot of the ground-state moments of inertia of even-even nuclei vs N and Z is shown. 3 figures. (RWR)

39084 (COO—2171-200) **Nuclear structure theory. Annual technical progress report, October 1, 1979-August 31, 1980.** French, J.B.; Koltun, D.S. (Rochester Univ., NY (USA)). 1980. Contract AS02-76ER02171. 11p. NTIS, PC A02/MF A01.

This report summarizes progress during the past year in the following areas of nuclear structure and reaction theory: statistical spectroscopy (including random matrix methods, with applications to fluctuations in spectra and in strength distributions, and to problems of ergodicity; group symmetries in spectral-distribution theory; electromagnetic and β transitions); meson scattering and absorption by nuclei (including general scattering theory with absorption, multiple scattering theory and its reactive content, statistical theory of absorption); and meson currents in electromagnetic transitions.

39085 Theory of nuclear molecules. Scheid, W. (Justus-Liebig-Universitaet, Glessen, Germany); Greiner, W. pp 295-310 of Future directions in studies of nuclei far from stability. Hamilton, J.H.; Spejewski, E.H.; Bingham, C.R.; Zganjar, E.F. (eds.). New York, NY; North-Holland Publishing Co. (1980).

From International symposium on future directions in studies of nuclei far from stability; Nashville, TN, USA (10 Sep 1979).

Specific problems associated with nuclear molecules are reviewed in the framework of collective and microscopic models. The principal properties of molecular states are discussed first. Then the intrinsic configuation of the molecular resonances are considered according to the following scheme: states with a single intrinsic configuration (elastic scattering) - sudden and adiabatic approximations, molecular resonances, the absorptive potential; states with configuration mixing of the intrinsic structure (inelastic excitation and cluster transfer - double resonance mechanism and inelastic excitation, molecular intrinsic configurations, cluster transfer. 20 figures. (RWR)

39086 Particle properties of collective states. Peker, L.K. (Brookhaven National Lab., Upton NY); Hamilton, J.H. pp 323-335 of Future directions in studies of nuclei far from stability. Hamilton, J.H.; Spejewski, E.H.; Bingham, C.R.; Zganjar, E.F. (eds.). New York, NY; North-Holland Publishing Co. (1980).

From International symposium on future directions in studies of nuclei far from stability; Nashville, TN, USA (10 Sep 1979).

An analysis is made of the available data on possible two-phonon vibrational states in light of the expectations of a pure phonon collective model. Also the microscopic structure of $2^+\gamma$-vibrational states and the E1 branchings to 0^+ and 2^+ states from octupole states are analyzed. All these data show strong deviations from the properties expected in a pure collective picture. These deviations suggest that the particle properties of these states are important features that must be considered in any detailed analysis. 11 figures, 2 tables.

NUCLEAR MATTER

REFER ALSO TO CITATION(S) 39088

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 39047, 39093

39087 (LA-UR—80-2673) **Use of R-matrix methods for light element evaluations.** Hale, G.M. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 23p. (CONF-800979—4). NTIS, PC A02/MF A01.

From Workshop on nuclear data evaluation methods and procedures; Upton, NY, USA (22 Sep 1980).

Some general aspects of parameterizing nuclear reaction data with a unitary, multichannel theory are discussed. The special case of R-matrix theory are discussed. The special case of R-matrix theory is considered, where the explicit separation of long- and short-range forces and the natural occurrence of energy pole terms afford a number of advantages in describing data for light-element reactions. Examples are given for both neutron- and charged-particle-induced reactions which illustrate multichannel R-matrix techniques, including the use of charge symmetry to relate data for mirror systems. The limitations of conventional R-matrix methods are discussed briefly.

39088 (LBL—11040) **Relativistic nuclear collisions: theory.** Gyulassy, M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jul 1980. Contract W-7405-ENG-48. 61p. NTIS, PC A04/MF A01.

Some of the recent theoretical developments in relativistic (0.5 to 2.0-GeV/nucleon) nuclear collisions are reviewed. The statistical model, hydrodynamic model, classical equation of motion calculations, billiard ball dynamics, and intranuclear cascade models are discussed in detail. Inclusive proton and pion spectra are analyzed for a variety of reactions. Particular attention is focused on how the complex interplay of the basic reaction mechanism hinders attempts to deduce the nuclear matter equation of state from data. 102 references, 19 figures.

39089 (NPRU—79/6, pp vp) **Role of deep inelastic processes in nuclear physics. Experimental and theoretical aspects of deep inelastic reactions.** Moretto, L.G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1978.

From Conference on dynamical properties of heavy-ion reactions; Johannesburg, South Africa (1 Aug 1978).

The collective modes excited in deep-inelastic reactions and their natural hierarchy provided by their characteristic relaxation times is described. The relaxation of the mass asymmetry mode is discussed in terms of a diffusion process. Charge distributions and angular distributions as a function of Z calculated with this model are in good agreement with experimental data. This diffusion model also treats the transfer of energy and angular momentum in terms of particle transfer, and is successfully compared with experimental γ-ray multiplicities as a function of both Q-value and mass asymmetry. The angular momentum transfer is again considered in connection with the sequential fission of heavy, deep-inelastic fragments and the excitation of collective modes in the exit channel is considered. The role of the giant E1 mode in the equilibration of the neutron-to-proton ratio is discussed.

39090 **Theory of energy-independent nuclear optical-model potentials.** Kuo, T.T.S.; Osterfeld, F.; Lee, S.Y. (Institut fuer Kernphysik, Kernforschungsanlage Juelich, D-5170 Juelich, Federal Republic of Germany). EY-76-S-02-3001. *Phys. Rev. Lett.;* **45**: No. 10, 786-790(8 Sep 1980).

With use of an equation-of-motion approach, a new microscopic theory of the nuclear optical-model potential which is explicitly energy independent has been derived. This theory suggests the possibility of replacing a wide range of conventional energy-dependent optical-model potentials by a single, energy-independent but nonlocal, optical-model potential.

NUCLEAR MODELS

REFER ALSO TO CITATION(S) 39083, 39090

39091 **Do we understand the spectra in transitional even mass and odd-odd mass nuclei.** Faessler, A. (Univ., Tuebingen, Germany). pp 1-13 of Future directions in studies of nuclei far from stability. Hamilton, J.H.; Spejewski, E.H.; Bingham, C.R.; Zganjar, E.F. (eds.). New York, NY; North-Holland Publishing Co. (1980).

From International symposium on future directions in studies of nuclei far from stability; Nashville, TN, USA (10 Sep 1979).

The decoupling model is extended to describe odd-odd mass nuclei, where in addition to zero quasi particles also two quasi particles are admixed. Both particles can decouple (the peaceful case) or one particle can decouple and the other can couple strongly to the deformed core (the conflicting case). In both cases typical spectra are quite different from each other. In odd-odd and even mass nuclei rules that simplify the analysis of the experimental data are established. Examples from the Os, Pt, Hg region are discussed. 11 figures.

39092 **New facets of quadrupole phonon.** Paar, V. (Univ., Zagreb, Yugoslavia). pp 15-36 of Future directions in studies of nuclei far from stability. Hamilton, J.H.; Spejewski, E.H.; Bingham, C.R.; Zganjar, E.F. (eds.). New York, NY; North-Holland Publishing Co. (1980).

From International symposium on future directions in studies of nuclei far from stability; Nashville, TN, USA (10 Sep 1979).

A systematic approach to even-even, odd-even, and odd-odd nuclei, based on spherical quadrupole phonons, is discussed. The truncated quadrupole-phonon model (TQM), based on SU(6) symmetry, describes even-even nuclei in the collective approximation. In the particle-TQM interaction model (PTQM), an odd single particle is coupled to the TQM core. In the SU(#) limit of the PTQM, analogs of Nilsson states appear. In the cluster-vibration model, even-even, odd-even, and odd-odd nuclei are described by coupling a few selected shell-model single particles to the quadrupole vibration (harmonic or TQM). The quasicluster-vibration model (QCVM) is an approximation of the CVM in the sense that the cluster consists of a few quasiparticles. Both the diagonalization and the diagrammatic approaches are discussed. The latter leads to generalized vibrational rules (GVR), as a consequence of the nuclear Ward identity. 106 references, 2 tables.

39093 **Quartet effects in masses and in charge exchange reactions.** Danos, M. (National Bureau of Standards, Washington, DC). pp 195-207 of Future directions in studies of nuclei far from stability. Hamilton, J.H.; Spejewski, E.H.; Bingham, C.R.; Zganjar, E.F. (eds.). New York, NY; North-Holland Publishing Co. (1980).

From International symposium on future directions in studies of nuclei far from stability; Nashville, TN, USA (10 Sep 1979).

A mass formula based on the quartet model is presented; some differences in its predictions with that of other mass formulas are pointed out. The possibility of reaching highly unstable nuclei by charge-exchange reactions is discussed. It is shown that surface quartets play a decisive role in multiple charge transfer processes. 6 figures, 2 tables.

39094 **Some applications of the shell correction method.** Ragnarsson, I. (CERN, Geneva Switzerland). pp 367-387 of Future directions in studies of nuclei far from stability. Hamilton, J.H.; Spejewski, E.H.; Bingham, C.R.; Zganjar, E.F. (eds.). New York, NY; North-Holland Publishing Co. (1980).

From International symposium on future directions in studies of nuclei far from stability; Nashville, TN, USA (10 Sep 1979).

For some different regions of nuclei away from stability, recent experimental results are compared to theoretical calculations. For example, for odd neutron-deficient Hg isotopes with coexistence between different shapes, potential energy surfaces are calculated in the (ϵ,γ) plane with full inclusion of the Coriolis term. Furthermore, the permanently deformed neutron-rich $A \simeq 100$ nuclei are discussed, and some results concerning hexadecapole deformations for neutron-rich Yb, Hf, and W nuclei are presented. It is shown how the general trends of the shell effects at large prolate deformations follow quite general trends and how these trends as well as the tendencies toward asymmetric deformations for specific particle numbers can be understood. The methods developed to describe the shell effects as a function of deformation and particle number can be generalized to include also rotational frequency, and the shell effects at large angular momenta are briefly discussed. 19 figures, 1 table.

RADIATION AND SHIELDING PHYSICS

RADIATION PHYSICS

REFER ALSO TO CITATION(S) 38910

39095 (HEDL-SA—2228FP) **Point Monte Carlo data needs and constraints.** Carter, L.L. (Hanford Engineering Development Lab., Richland, WA (USA)). Aug 1980. Contract AC14-76FF02170. 13p. NTIS, PC A02/MF A01.

The utilization of neutron and photon cross section data in pointwise Monte Carlo codes is discussed. As nuclear data files become more prolific, memory requirements for typical problems can exceed the memory available on modern computers. Evaluators and processors of the cross sections must work together to provide high-quality cross sections for the user community without exceeding memory requirements. 2 tables.

NEUTRON INTERACTIONS WITH MATTER

REFER ALSO TO CITATION(S) 38389, 38390, 39069, 39095

SOLID STATE PHYSICS

REFER ALSO TO CITATION(S) 37830

39096 Ising gauge theory at negative temperatures and spin-glasses. Bhanot, G.; Creutz, M. (Department of Physics, Brookhaven National Laboratory, Upton, New York 11973). DE-AC0Z-76CH00016. *Phys. Rev., B: Condens. Matter;* **22**: No. 7, 3370-3373(1 Oct 1980).

We study the Z(2) coupled spin-gauge theory at negative gauge coupling. We find two frustrated phases and a disordered phase in both three and four dimensions. All critical lines are of first order in four dimensions. In three dimensions, the frustration bold-arrow-left-right frustration transition as well as one of the frustration bold-arrow-left-right disorder lines appear to be of second order. We find that the contour in the coupling parameter space along which the unit Wilson loop vanishes intersects a transition line only at infinite negative gauge coupling and infinite spin-spin coupling. This indicates that, contrary to a recent conjecture, this contour cannot describe a transition in spin-glasses.

39097 ac hopping conductivity of one-dimensional bond-percolation model. Odagaki, T.; Lax, M. (Department of Physics, The City College of the City University of New York, New York, New York 10031). *Phys. Rev. Lett.;* **45**: No. 10, 847-850(8 Sep 1980).

The exact frequency dependence of the ac hopping conductivity of a one-dimensional chain with random interruptions is obtained. The real and imaginary parts of the ac conductivity are shown to vanish quadratically and linearly, respectively, with frequency at the static limit. Critical behavior of the ac conductivity in the limit of no interruptions is discussed.

SUPERCONDUCTIVITY

ACOUSTIC, ELECTRIC, MAGNETIC, OPTICAL, AND THERMAL PHENOMENA

REFER ALSO TO CITATION(S) 38368

39098 Theory of the upper critical field in quasi-zero-dimensional superconductors. Youngner, D.W.; Peterson, A.S. (Ames Laboratory: USDOE and Department of Physics, Iowa State University, Ames, Iowa). W-7405-ENG-82. *J. Low Temp. Phys.;* **40**: No. 1, 59-70(1 Jul 1980).

A microscopic theory describing the upper critical field in quasi-zero-dimensional superconductors is presented. The model is applicable to materials in which the superconducting electrons form clusters which are spatially separated from each other. It is argued that in quasi-zero-dimensional superconductors the orbital upper critical field is apt to be very high, and it is predicted that in highly zero-dimensional superconductors the H/sub c/2(T) curve will exhibit structure not yet seen experimentally.

THEORETICAL PHYSICS

CLASSICAL AND QUANTUM MECHANICS

REFER ALSO TO CITATION(S) 38935, 39104

STATISTICAL PHYSICS AND THERMODYNAMICS

39099 Nonlinear partial difference equations for the two-dimensional Ising model. McCoy, B.M.; Wu, T.T. (The Institute for Theoretical Physics, State University of New York, Stony Brook, New York 11794). DE-A502-76-ER03227. *Phys. Rev. Lett.;* **45**: No. 9, 675-678(1 Sep 1980).

The two-point function of the two-dimensional Ising model at arbitrary temperature is expressed in terms of the solution of a nonlinear partial difference equation. From this difference equation the known results for the two-point function of the Ising field theory may be regained as a special case.

39100 (UCRL-Trans—11625) Models of the equations of state of matter. Fortov, V.E. (AN SSSR, Chernogolovka. Otdelenie Inst. Khimicheskoj Fiziki). Sep 1980. Translation source information not available . 123p. NTIS, PC A06/MF A01.

Topics covered include: equations of state of gases; thermodynamic models of plasma; the quasi-classical model; quantum mechanical models of solids; models of liquids; phase boundaries; and semiempirical models of the condensed phase. 165 references. (GHT)

39101 Remark on a model of condensation due to Ford and Uhlenbeck. Lee, H.M.; Dekeyser, R. (Univ. of Georgia, Athens). pp 508-511 of Annals of Israel Physical Society. Volume 2. Cabib, D.; Kuper, C.; Riess, I. (eds.). Jerusalem, IL; Israel Physical Society (1978).

From 13. international conference on statistical physics; Haifa, Israel (24 Aug 1978).

The model of condensation due to Ford and Uhlenbeck is studied to illustrate further the ideas of Lee and Yang about phase transitions. In particular, the connection between the zeros of the grand canonical partition function and the cluster integrals of Mayer is explicitly demonstrated. In an effort to give a physical interpretation, this model is compared with a gas-solid absorption system.

MATHEMATICAL PHYSICS

39102 (UCID—18682) NOTRUMP, an updated version of TRUMP. Thorson, L.D. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 29 Sep 1980. Contract W-7405-ENG-48. 19p. NTIS, PC A02/MF A01.

A description is given of a new version of the TRUMP [UCRL-14754] computer code, NOTRUMP, which runs on both the CDC-7600 and CRAY-1. There are slight differences in the input and major changes in output capability. A postprocessor, AFTER, is available to manipulate some of the new output features. Old data decks for TRUMP will normally run with only minor changes.

39103 Coupled Klein-Gordon-Schroedinger equations. II. Fukuda, I. (Kokushikan Univ., Tokyo, Japan). *J. Math. Anal. Appl.;* **66**: No. 2, 358-378(15 Nov 1978).

A classical model that describes a system of conserved scalar nucleons interacting with neutral scalar mesons is considered. The dynamics of these fields are coupled through the Yukawa interaction. In the case of relativistic fields, that is, when nucleons are described by Dirac spinor fields, the coupled Klein-Gordon-Dirac equations are encountered. Both Klein-Gordon-Dirac equations and Klein-Gordon-Schroedinger equations have energy forms indefinite in nature. The initial-boundary value problem for the coupled Klein-Gordon-Schroedinger equations in three space dimensions is discussed here. The purpose is to establish the existence and uniqueness theorems of global C/sup x/-solutions of the initial-boundary value problem. The main difficulties lie in the proof of the existence of strong solutions and their regularity properties. (RWR)

COMMUNICATION, EDUCATION, HISTORY, AND PHILOSOPHY

39104 (DOE/ER/03992—387) Note on Zeno's paradox in quantum theory. Kraus, K. (Texas Univ., Austin (USA). Center for Particle Theory). Feb 1980. Contract AS05-76ER03992. 20p. NTIS, PC A02/MF A01.

A decaying quantum system, if observed very frequently in order to ascertain whether or not it is still undecayed, will not decay at all. The derivation of this effect - known, e.g., as Zeno's paradox - has been criticized recently. It has been argued that measurements performed in a very short time interval, Δt, produce states with a very large energy uncertanty, ΔE, and that Zeno's paradox disappears if this is taken into account. By construction of an explicit counterexample it is proved, however, that there is no energy-time uncertainty relation of the required kind; therefore, the criticism mentioned is unjustified.

39105 Nuclei far from the stability line and subjectivity. Foucher, R. (Institut de Physique Nucleaire, Orsay, France). pp 365-366 of Future directions in studies of nuclei far from stability. Hamilton, J.H.; Spejewski, E.H.; Bingham, C.R.; Zganjar, E.F. (eds.). New York, NY; North-Holland Publishing Co. (1980).

From International symposium on future directions in studies of nuclei far from stability; Nashville, TN, USA (10 Sep 1979).

The role of subjectivity and preconceived ideas in the interpretation of nuclear data is pointed out. 1 figure. (RWR)

39106 Understanding rapid theoretical change in particle physics: a month-by-month co-citation analysis. Sullivan, D.; Koester, D.;

White, D.H.; Kern, R. (Brookhaven National Lab., Upton, NY). *Proc. ASIS Annu. Meet.;* **16**: 276-285(1979). (CONF-7910144—).

From 42. annual meeting of the American Society for Information Science; Minneapolis, MN, USA (14 Oct 1979).

While co-citation analysis has proved a powerful tool in the study of changes in intellectual foci in science, no one has ever used the technique to study very rapid changes in the theoretical structure of a scientific field. This paper presents month-by-month co-citation analyses of key phases in the weak-electromagnetic unification research program within particle physics, and shows that these analyses capture and illuminate very rapid intellectual changes. These data provide yet another illustration of the utility of co-citation analysis for understanding the history of science. 8 figures.

FUSION ENERGY

PLASMA RESEARCH

PLASMA CONFINEMENT AND HEATING

39107 (CONF-790463—2) **Plasma physics of intense neutral beam heating in tokamaks.** Callen, J.D.; Rome, J.A. (Oak Ridge National Lab., TN (USA)). 1979. Contract W-7405-ENG-26. 14p. NTIS, PC A02/MF A01.

From IAEA technical committee and workshop on the plasma physics of intense neutral beam heating in Tokamaks; Oak Ridge, TN, USA (25 Apr 1979).

Portions of document are illegible.

The major conclusions of the workshop were: 1) neutral beam heating is still an infant and difficult technology: 2) neutral beam heating experiments have just begun to explore the P/sub inj/ much greater than P/sub ohmic/ regime; 3) no obvious injection-specific limits of neutral beam heating have been found for powers up to 2.4 MW in PLT, or up to ≧ 1 MW in the smaller DITE, ISX-B and T-11 experiments; 4) an ever-increasing number of high power injection experiments are planned over the next few years; and 5) the classical, Coulomb-collision based theory of neutrlal beam injection is in good agreement with experimental results and is presently progressing to a stage which is primarily one of computer code development and experiment evaluation and interpretation.

39108 (DOE/ER/53092—T3) **Microwave heating of the ELMO Bumpy Torus relativistic electron ring. Status report, November 1, 1979-September 30, 1980.** Hamasaki, S.; Klein, H.H.; Krall, N.A.; McBride, J.B.; Sperling, J.L. (JAYCOR, Del Mar, CA (USA)). Oct 1980. Contract AC03-80ER53092. 54p. NTIS, PC A04/MF A01.

An introduction describes the critical importance of the relativistic electron rings to the EBT concept and the significance of electron-cyclotron heating to the formation and steady state of the rings. The relation and distinctive features of the present work to previous calculations of ring power balance are delineated. The plasma model used as the basis of the calculations is set up. Special emphasis is given to the development and description of a relativistically correct quasilinear expression. Equations for collisional, synchrotron radiation, and bremsstrahlung losses which are necessary for determining steady state annulus temperatures are written down. The energy loss and quasilinear heating equations are adapted to EBT geometry. A detailed accounting is given of spatial locations where quasilinear heating occurs for various electron cyclotron harmonics. The final section makes concluding remarks about the JAYCOR EBT ring model. A brief synopsis is given of the significant points deduced from the model, particularly as they relate to recent EBT experiments. Based on the results, suggestions for future refinements in the JAYCOR ring model are made which can permit improvement in the theoretical description of the EBT ring.

39109 (ORNL/TM—7452) **ISX-B neutral beams and the beam target experiment.** Bates, S.C.; Edmonds, P.H.; Kim, J.; Bush, C.E.; Massengill, L.A.; Overbey, D.R.; Pearce, J.W. (Oak Ridge National Lab., TN (USA)). Oct 1980. Contract W-7405-ENG-26. 63p. NTIS, PC A04/MF A01.

This report describes the hardware and operation of the ISX neutral beamlines as well as an experiment done to verify estimates of the neutral power injected into the tokamak. Tangential coinjection of megawatt levels of 30 to 40-keV neutrals into the tokamak has made the study of high-beta plasmas in ISX possible. These power levels were achieved with high reliability (over 90%) by two neutral beamlines with design power ratings of 900 kW of H^0 (upgraded to 1.5 MW) each. The neutral beamlines consist of a duoPIGatron plasma generator, acceleration grids, a gas neutralization cell, an ion deflection magnet, beam calorimetry, high-speed helium cryocondensation vacuum pumps, and associated electrical and control systems. The beamlines and their operation are described briefly with an emphasis on their relation to injection into a plasma. Neutral injection geometry with respect to the tokamak is given.

39110 (ORNL/TM—7503) **Currents induced in tokamaks by electron cyclotron heating.** Eldridge, O.C. (Oak Ridge National Lab., TN (USA)). Oct 1980. Contract W-7405-ENG-26. 34p. NTIS, PC A03/MF A01.

Generation of a plasma current is predicted in association with strong electron cyclotron heating in tokamaks or in any plasma with transverse magnetic field gradients. The current predicted in present-day tokamaks is of the order of one-quarter ampere per watt, which is large enough to be detected in heating experiments in progress. The current scales linearly with electron temperature and heating power and inversely with density and major radius. The mechanism depends on the Doppler shift for electrons streaming along magnetic field lines. Electrons streaming toward the source of radiation are resonant at a larger magnetic field. When the interaction is strong, radiation incident from the high field side is absorbed before reaching the cold electron resonant surface, and, so, a unidirectional population of electrons is heated. The anisotropic electron distribution gains momentum by collisions with ions. For small tokamaks the extraordinary wave should be launched for current drive, but for reactors the ordinary wave produces a sufficiently strong interaction.

39111 (PPPL—1697) **Mode converter for electron cyclotron resonance heating of toroidal plasmas.** Motley, R.W.; Hsuan, H.; Glanz, J. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Sep 1980. Contract AM02-76CH03073. 16p. NTIS, PC A02/MF A01.

A method is proposed for improving the efficiency of cyclotron resonance heating of a toroidal plasma by ordinary mode radiation from the outside of the torus. Radiation not absorbed in the first pass is reflected from the inside of the torus by a corrugated surface which rotates the polarization by 90°, so that a secondary source of extraordinary waves is created in the high field, accessible region of the plasma.

39112 (UCID—18802) **Model for ion confinement in a hot-electron tandem mirror anchor.** Baldwin, D.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Sep 1980. Contract W-7405-ENG-48. 16p. NTIS, PC A02/MF A01.

Anisotropic, hot electrons trapped in local minimum-B wells have been proposed as MHD-stabilizing anchors to an otherwise axisymmetric tandem configuration. This work describes a model for plasma confinement between the anchors and the remainder of the system and calcuates the power loss implied by maintenance of this plasma.

39113 **Resistive wall interaction of axially moving field-reversed E layers or plasma rings.** Rej, D.J.; Larrabee, D.A.; Fleischmann, H.H. (School of Applied and Engineering Physics, Cornell University, Ithaca, N.Y. 14853). DE-AS02-76ET53017. *J. Appl. Phys.;* **51**: No. 10, 5285-5291(Oct 1980).

Calculations are performed of the interaction force between an axially moving current carrying plasma ring or E layer with a resistive wall for a variety of parameters relevant to various moving-ring fusion schemes and experiments. Various wall configurations are considered: (i) For a thin resistive wall, the interaction force F/sub r/(v/sub z/) is found to be proportional to the axial speed v/sub z/ or to (1/v/sub z/) for small or large velocities, respectively, and to be strongly dependent on the ratio of the effective ring radius R to wall radius R/sub w/. In contrast, the force dependence on the ring thickness δR is found small when rings with similar external field distributions are compared. For fusion-relevant ratios R/R/sub w/< or ≃0.7, and L/R=1—2 (L=ring length), the energy losses for moving the rings an axial distance equal to L may amount to 25% of the rings' magnetic self-energy. However, this energy can be strongly reduced by proper choice of parameters. (ii) The addition of a fully flux-conserving wall at a radius R/sub c/>R/sub w/ is also found to lead to significant reductions of F/sub r/(v) in the low-velocity regime, dependent in size on the ratio α=R/sub c//R/sub w/. (iii) A finite wall thickness mainly will lead to increases in F/sub r/(v) at large v/sub z/, where the transit time of the rings t/sub t/ ≃(R²/sub w/+L²)/sup 1/2//v/sub z/ becomes shorter than skin-depth time of the wall. In this case, F/sub r/(v) ∼v/sup -1/2//sub z/ is obtained.

39114 **Creating an asymmetric plasma resistivity with waves.** Fisch, N.J.; Boozer, A.H. (Princeton University, Plasma Physics Laboratory, Princeton, New Jersey 08544). DE-AC02-76-CHO-3073. *Phys. Rev. Lett.;* **45**: No. 9, 720-722(1 Sep 1980).

Preferential heating of electrons traveling in one direction can support a current even in the absence of a dc electric field. An immediate implication is that even waves which carry little toriodal momentum, such as electron cyclotron waves, may be attractive as a means for generating steady-state toroidal current in a tokamak. An analytical expression is derived for the current generated per power dissipated, which agrees remarkably well with numerical calculations.

PLASMA DIAGNOSTICS

REFER ALSO TO CITATION(S) 39174

39115 (CONF-801037—17) **Impurity studies in fusion devices using laser-fluorescence-spectroscopy.** Husinsky, W.R. (Oak Ridge National Lab., TN (USA)). Aug 1980. Contract W-7405-ENG-26. 32p. NTIS, PC A03/MF A01.

From American Vacuum Society conference; Detroit, MI, USA (13 Oct 1980).

Resonance fluorescence excitation of neutral atoms using tunable radiation from dye lasers offers a number of unique advantages for impurity studies in fusion devices. Using this technique, it is possible to perform local, time-resolved measurements of the densities and velocity distributions of metallic impurities in fusion devices without disturbing the plasma. Velocities are measured by monitoring the fluorescence intensity while tuning narrow bandwidth laser radiation through the Doppler - broadened absorbtion spectrum of the transition. The knowledge of the velocity distribution of neutral impurities is particularly useful for the determination of impurity introduction mechanisms. The laser fluorescence technique will be described in terms of its application to metallic impurities in fusion devices and related laboratory experiments. Particular attention will be given to recent results from the ISX-B tokamak using pulsed dye lasers where detection sensitivities for neutral Fe of 10^8 atoms/cm^3 with a velocity resolution of 600 m/sec (0.1 eV) have been achieved. Techniques for exciting plasma particles (H,D) will also be discussed.

39116 (NRL-MR—4353) **Interferometric measurement of small refraction angles.** Stamper, J.A. (Naval Research Lab., Washington, DC (USA)). 15 Oct 1980. Contract AI01-77DP40042. 9p. NTIS, PC A02/MF A01.

Radial and axial refraction angles are separately measured for rays passing through an azimuthally symmetric medium. The fringe slopes from complementary interferograms are used in a derived expression. Shearing interferometry is used in an example.

39117 (ORNL—5645, pp 73-78) **Diagnostic development.** Aug 1980.

In Fusion Energy Division annual progress report period ending December 31, 1979.

A new linear high-power laser oscillator has been constructed for the submillimeter-wave laser Thomson scattering experiment. Profiles of electron density and plasma current density have been simultaneously measured on the Impurity Study Experiment-B (ISX-B) with a four-channel, combined interferometer-polarimeter operating at a wavelength of $\sim$ 0.4 mm. The measurements of the plasma current density profiles are the first to be made on a tokamak using Faraday rotation of submillimeter-wave-length radiation. A low-energy neutral particle spectrometer is being constructed to measure the fluxes of hydrogen and of impurities such as carbon, oxygen, and iron from ISX-B. This spectrometer uses a cesium vapor cell to produce negative ions and will be calibrated using known neutral beam fluxes produced by laser photodetachment of negative ions with energies ranging from 10-500 eV. A neutral beam analyzer for measuring the fractions of the neutral H^0 particles at full energy E (originally H^+), one-half energy E/2 (originally H_3^+), and one-third energy E/3 (originally H_3^+) has been calibrated.

39118 (ORNL/TM—7437) **Electron heating and confinemet measurements in EBT-S using Thomson scattering.** Bighel, L.; Cobble, J.A. (Oak Ridge National Lab., TN (USA)). Sep 1980. Contract W-7405-ENG-26. 29p. NTIS, PC A03/MF A01.

Thomson scattering of ruby laser light was used to measure electron temperatures and densities in the ELMO Bumpy Torus-Scale (EBT-S) at Oak Ridge National Laboratory. The measurements were made primarily during May 1980, although some were taken during January 1980. The scattering system, which was designed for very low electron density measurements, features a 14-J ruby laser, a high-throughput spectrometer, and 15% quantum efficiency photomultipliers. The measured electron densities lie in the range 5 X 10^{11} cm^{-3} to 2.2 X 10^{12} cm^{-3} with electron temperatures from 50 to 500 eV. The radial profiles of T/sub e/ and n/sub e/ are reasonably flat over an 8-cm region from the plasma center outward. The dependence of T/sub e/ and n/sub e/ on microwave power input and on background pressure is discussed. The electron data are used to derive approximate values of the energy confinement time.

PLASMA KINETICS - GENERAL

39119 (DOE/ET/53051—8) **Abstracts of papers presented at the twenty-second annual meeting of the Division of Plasma Physics of the American Physical Society.** (Wisconsin Univ., Madison (USA)). 1980. Contract AS02-76ET53051. 12p. (CONF-801119—(Exc.)(Absts.)). NTIS, PC A02/MF A01.

From 22. annual meeting of the division of plasma physics of the APS; San Diego, CA, USA (10 Nov 1980).

Nine abstracts are included in this document. (MOW)

PLASMA KINETICS - EXPERIMENTAL

39120 (DOE/ER—0065) **Mirror Confinement Systems: project summaries.** (Department of Energy, Washington, DC (USA). Office of Energy Research). Jul 1980. 55p. NTIS, PC A04/MF A01.

This report contains descriptions of the projects supported by the Mirror Confinement Systems (MCS) Division of the Office of Fusion Energy. The individual project summaries were prepared by the principal investigators, in collaboration with MCS staff office, and include objectives and milestones for each project. In addition to project summaries, statements of Division objectives and budget summaries are also provided.

39121 (DOE/ET/53081—1) **Experimental program based on a High Beta Q Machine. Final report, 1 May 1978-30 September 1980.** Ribe, F.L. (Washington Univ., Seattle (USA). Fusion Plasma Program). Jul 1980. Contract AT06-76ET53081. 45p. NTIS, PC A03/MF A01.

This report summarizes work done in designing and constructing the High Beta Q Machine from the inception of the work in May 1978 until the present time. It is a 3-m long, low-compression theta pinch with a 22-cm-diameter segmented compression coil with a minimum axial periodicity length of 10 cm. This capability of driving the machine as a simple, low-density theta pinch, and also of independently applying periodic magnetic fields before or after formation of the plasma column, gives the device considerable flexibility. Reported here is the construction and testing of the machine, development of its diagnostics and initial measurements of the plasma at early times in the duration of the crowbarred magnetic field. The experimental effort has been paralleled by theoretical work to model the diffuse profile, collisionless plasma in its response to the periodic RF magnetic fields. The model chosen is the Freidberg-Pearlstein Vlasov-fluid model which provides an MHD-like description but with accounting of ion kinetic effects over diffuse equilibrium profiles. A computer code has been developed to accurately calculate the resistive response of the plasma column, giving the power absorption by ion Landau damping and more recently, ion-cyclotron damping.

39122 (ORNL—5645, pp 3-71) **Experimental confinement.** Aug 1980.

In Fusion Energy Division annual progress report period ending December 31, 1979.

ELMO Bumpy Torus (EBT) operations were halted for much of the year because of a major overhaul of the motor-generator sets that provide power for the steady-state toroidal magnets. At peak steady-state output, the generators supply 10 MW. Several improvements have been made to the plasma diagnostic array, and the details can be found in the description of each diagnostic. Much time and effort were spent discerning and improving the limits of accuracy for the diagnostics. One of the additions, although only partially implemented, is computer-aided data acquisition. The ISX-B (Impurity Study Experiment) program emphasized the study of several issues relevant to the development of fusion reactors. These studies included high-beta tokamak operation, plasma shaping, pellet fueling, electron cyclotron heating (ECH), magnetic field ripple effects, and impurity analysis and control. An rms beta of 3.3% has been achieved; this is above theoretical thresholds for pressure driven MHD instabilities. Plasmas that are D-shaped with an elongation of up to 1.5 have been produced, and density rises of up to a factor of five were observed when 1-mm-diam pellets were injected into the plasma at a velocity of $\approx$ 1 km/s. A 35-GHz gyrotron injected 85 kW of microwaves into a plasma, resulting in a 50% increase in the central electron temperature. Initial loop voltage was reduced $\approx$ 40% as a result of ECH preionization. Magnetic field ripples of up to 1.5% have produced large fast ion losses but much smaller thermal ion losses and flux surface perturbations. Characteristics of the edge plasma were studied by surface analysis (ion scattering, channeling, and nuclear reaction techniques) of samples placed in the shadow of the limiter. Laser-induced fluorescence diagnostic systems developed by General Atomic (GA) and Juelich have successfully measured impurity density near the plasma edge for the first time in tokamaks.

39123 (ORNL—5645, pp 127-137) **Atomic, molecular, and nuclear physics.** Aug 1980.

In Fusion Energy Division annual progress report period ending December 31, 1979.

Atomic physics activities encompass: (1) experimental studies of basic atomic collision processes of interest to fusion research; (2) some theoretical studies of these processes; and (3) categorization and compilation by the data center of fusion-related atomic data from the literature.

39124 (UCRL—52993) **Experimental study of finite Larmor radius effects.** Struve, K.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Aug 1980. Contract W-7405-ENG-48. 206p. NTIS, PC A10/MF A01.

Thesis.

Linear Z-pinches in Ar, Kr, Xe, N_2, and He are experimentally studied in regimes where strong finite Larmor radius effects could provide a significant stabilizing effect. Scaling arguments show that for deuterium such a pinch has an electron line density of order 2 x 10^{15}/cm. For higher Z plasmas a higher line density is allowed, the exact value of which depends on the average ion charge. The pinch is formed by puffing gas axially through the cathode towards the anode of an evacuated pinch chamber. When the gas reaches the anode, the pinch bank is fired. The pinch current rises in 2 to 3 μsec to a maximum of 100 to 200 kA. The pinch bank capacitance is 900 μF, and the external inductance is 100 nH. Additionally, the bank is fused to increase dI/dt. The primary diagnostics are a framing camera, a spatially resolved Mach-Zehnder interferometer, and X-ray absorption.

PLASMA KINETICS - THEORETICAL

39125 (COO—2218-171) **Quasi-steady operation of reversed field pinches.** Nebel, R.A. (Illinois Univ., Urbana (USA). Fusion Studies Lab.). 1980. Contract AS02-76ET52040. 141p. NTIS, PC A07/MF A01.

Thesis.

A three fluid, Lagrangian mesh, transport and stability code (RFPBRN) has been developed and applied to the Reversed Field Pinch reactor concept. Using a circular cylinder, quasi-static approximation, RFPBRN follows the time evolution of the temperature, density, and magnetic field profiles for the RFP while simultaneously monitoring ideal MHD stability. Local stability is monitored for Suydam modes while global stability is monitored using a Rayleigh-Ritz expansion of the energy principle.

39126 (DOE/ET/53051—113) **Stability analysis of cylindrical Vlasov equilibria.** Short, R.W. (Wisconsin Univ., Madison (USA)). 1979. Contract AS02-76ET53051. 224p. NTIS, PC A10/MF A01.

Thesis.

A general method of stability analysis is described which may be applied to a large class of such problems, namely those which are described dynamically by the Vlasov equation, and geometrically by clindrical symmetry. The method is presented for the simple case of the Vlasov-Poisson (electrostatic) equations, and the results are applied to a calculation of the lower-hybrid-drift instability in a plasma with a rigid rotor distribution function. The method is extended to the full Vlasov-Maxwell (electromagnetic) equations. These results are applied to a calculation of the instability of the extraordinary electromagnetic mode in a relativistic E-layer interacting with a background plasma.

39127 (ORNL—5645, pp 79-126) **Plasma theory.** Aug 1980.

In Fusion Energy Division annual progress report period ending December 31, 1979.

Extended summaries of the ELMO Bumpy Torus (EBT) theory, tokamak theory, and computing support efforts are given. Important new insights include: (1) an understanding of the role of the neutral particle boundary condition in determining thermal stability of low collisionality transport studies in EBT; (2) formulation of a model for predicting energy loss by the EBT hot electron rings; (3) an awareness that the stability in EBT of the coupled plasma and ring system remains an area requiring improved analysis; (4) enhancement of the resistive magnetohydrodynamic (MHD) tokamak stability codes to increase the realism of the treatment for high-temperature discharges and for finite aspect ratio and beta parameters; (5) interpretation of enhanced tokamak electron thermal losses as a consequence of stochastic magnetic fields calculated with a strong turbulence theory of drift waves in sheared magnetic fields; (6) development of codes for analyzing and minimizng losses of energetic particles caused by field ripple and bundle divertors; and (7) identification of the conflicting indications from ideal MHD stability requirements and long-pulse transport phenomena on the one hand, and of the observed tendency of tokamaks to provide best confinement for rather peaked profiles on the other.

39128 (UCRL—85033) **Numerical solution of initial-value problems in plasma physics.** Killeen, J. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). Oct 1980. Contract W-7405-ENG-48. 27p. NTIS, PC A03/MF A01.

The numerical models used in fusion research are briefly reviewed. The application of implicit difference techniques to problems in resistive magnetohydrodynamics, transport and the Fokker-Planck equation is discussed.

PLASMA INSTABILITIES

39129 (COO—2217-171) **Quasi-steady operation of reversed field pinches.** Nebel, R.A. (Illinois Univ., Urbana (USA)). 1980. Contract AS02-76ET52040. 140p. NTIS, PC A07/MF A01.

Thesis.

A three fluid, Lagrangian mesh, transport and stability code (RFPBRN) has been developed and applied to the Reversed Field Pinch reactor concept. Using a circular cylinder, quasi-static approximation, RFPBRN follows the time evolution of the temperature, density, and magnetic field profiles for the RFP while simultaneously monitoring ideal MHD stability. Local stability is monitored for Suydam modes while global stability is monitored using a Rayleigh-Ritz expansion of the energy principle.

39130 (NRL-MR—4316) **Spheromak tilting instability in cylindrical geometry.** Finn, J.M.; Manheimer, W.M.; Ott, E. (Naval Research Lab., Washington, DC (USA)). 25 Sep 1980. Contract AI01-76ET53020. 28p. NTIS, PC A03/MF A01.

The internal tilting instability in a force free spheromak plasma in cylindrical geometry is examined. It is found that this instability, originally found in spherical geometry, also occurs in cylindrical geometry. The analysis proceeds by first demonstrating that if no mode rational surface is present in the plasma, a necessary and sufficient condition for ideal magnetohydrodynamic instability is that there exist a solution to nabla x B/sub ~ m/ = μ/sub m/B/sub ~ m/, where B/sub ~ m/ ~ exp(im θ), with μ/sub m/ < μ/sub o/. Solutions to this equation are investigated using two approaches, by a series expansion and by a numerical solution of a modified set of linearized magnetohydrodynamic equations. The eigenvalue for the m = 1 mode satisfies $\mu_1 < \mu_0$ for L/a > 1.67. Since no mode rational surface exists for this elongation, an ideal magnetohydrodynamic mode, identified as the tilting mode, is unstable for these parameters. All modes with m > 1 are shown to be stable.

39131 **Stabilization of the current-driven electrostatic ion-cyclotron instability by lower-hybrid waves.** Wolf, N.S.; Majeski, R.; Lashinsky, H.; Tripathi, V.; Liu, C.S. (Institute for Physical Science and Technology, University of Maryland, College Park, Maryland 20742). *Phys. Rev. Lett.;* **45**: No. 10, 799-802(8 Sep 1980).

The current-driven electrostatic ion-cyclotron instability in a Q machine operated in the low-density regime ($\omega/\omega_{pe}/\omega_{ce})^2 << 1$ is stabilized by externally generated rf electrostatic fields in the lower-hybrid range. Stabilization is due to a resonant ponderomotive force, which reduces the instability frequency, thus increasing the ion-cyclotron damping. The experimental results are in good agreement with an analysis which describes the effect of rf power on the instability frequency shift and growth rate.

39132 (DOE/ET/53073—T1) **Ballooning mode second stability region for sequences of tokamak equilibria.** Sugiyama, L.; Mark, J.W.K. (Massachusetts Inst. of Tech., Cambridge (USA)). [nd]. Contract AC02-78ET53073. 39p. NTIS, PC A03/MF A01.

A numerical study of several sequences of tokamak equilibria derived from two flux conserving sequences confirms the tendency of high n ideal MHD ballooning modes to stabilize for values of the plasma beta greater than a second critical beta, for sufficiently favorable equilibria. The major stabilizing effect of increasing the inverse rotational transform profile q(Psi) for equilibria with the same flux surface geometry is shown. The unstable region shifts toward larger shear d ln q/d ln γ and the width of the region measured in terms of the poloidal beta or a pressure gradient parameter, for fixed shear, decreases. The smaller aspect ratio sequences are more sensitive to changes in q and have less stringent limits on the attainable value of the plasma beta in the high beta stable region. Finally, the disconnected mode approximation is shown to provide a reasonable description of the second high beta stability boundary.

PLASMA WAVE PHENOMENA

REFER ALSO TO CITATION(S) 39114, 39131

39133 **Observations of stimulated-Brillouin scattering initiated by ponderomotive force density fluctuations.** Huey, H.E.; Mase, A.; Luhmann, N.C. Jr.; DiVergilio, W.F.; Thomson, J.J. (University of California, Los Angeles, California 90024). DE-AC08079DP400116;DE-AS03-76-SF00034. *Phys. Rev. Lett.;* **45**: No. 10, 795-798(8 Sep 1980).

This Letter reports the first observations of stimulated Brillouin scattering in microwave interaction wisth a plasma, as verified by the satisfaction of the frequency- and wavelength-matching rules and growth rate. A small amount of chamber reflectivity causes ion fluctuations due to the standing-wave ponderomotive force, which then serve as an enhanced noise level for the initiation of the instability.

FUSION POWER PLANT TECHNOLOGY

39134 (CONF-801011—5) **ETF system code: composition and applications.** Reid, R.L.; Wu, K.F. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 6p. NTIS, PC A02/MF A01.

From 4. ANS topical meeting on the technology of controlled nuclear fusion; King of Prussia, PA, USA (14 Oct 1980).

A computer code has been developed for application to ETF tokamak system and conceptual design studies. The code determines cost, performance, configuration, and technology requirements as a function of tokamak parameters. The ETF code is structured in a modular fashion in order to allow independent modeling of each major tokamak component. The primary benefit of modularization is that it allows updating of a component module, such as the TF coil module, without disturbing the remainder of the system code as long as the input/output to the modules remains unchanged. The modules may be run independently to perform specific design studies, such as determining the effect of allowable strain on TF coil structural requirements, or the modules may be executed together as a system to determine global effects, such as defining the impact of aspect ratio on the entire tokamak system.

39135 (CONF-801037—21) **ETF reactor design status.** Sager, P.H. (Oak Ridge National Lab., TN (USA); General Atomic Co., San Diego, CA (USA)). 1980. Contract W-7405-ENG-26. 26p. NTIS, PC A03/MF A01.

From American Vacuum Society conference; Detroit, MI, USA (13 Oct 1980).

Conceptual design studies of a tokamak Engineering Test Facility (ETF) are being carried out as a joint laboratory-industry effort at the ETF Design Center at Oak Ridge National Laboratory (ORNL). Designs are being developed for two reactors, one with a bundle divertor and one with a poloidal divertor. These machines, which are designed for ignition and a burn time of 100 s, both have a major radius of 5.4 m, a plasma minor radius of 1.3 m, and a D-shaped plasma elongation of 1.6. The plasma chamber must be conditioned at 10^{-7} torr. During the 35-s dwell between burns, the chamber must be pumped down from 5 x 10^{-3} torr to 3 x 10^{-5} torr. In the design with the bundle divertor four pairs of compound cryopumps, each pump with a 2-m^2 cryosorption pumping surface, are installed to pump down the plasma chamber. In the design with the poloidal divertor the plasma chamber is evacuated with the ten pairs of compound cryopumps, each pump with a cryosorption pumping surface of 4.32 m^2, installed to handle the divertor load. In both cases the pumps are installed in pairs so that one set can be regenerated while the other set is on-line.

39136 (IAEA-CN—38/A-5) **Experiments in the ISX-B Tokamak: ECRH, ripple studies, pellet fueling, impurity flow reversal, and surface physics.** Isler, R.C.; Milora, S.L.; Arnurius, D.A. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 13p. (CONF-800707—22(Draft)). NTIS, PC A02/MF A01.

From 8. international conference on plasma physics and controlled nuclear fusion research; Brussels, Belgium (1 Jul 1980).

The wide variety of experiments on the ISX-B Tokamak includes electron cyclotron heating, ripple effects, hydrogen pellet fueling, impurity flow reversal mechanisms, plasma edge studies, and testing of limiter coatings. The most significant results in each of these areas is discussed.

39137 (ORNL—5645) **Fusion Energy Division annual progress report period ending December 31, 1979.** (Oak Ridge National Lab., TN (USA)). Aug 1980. Contract W-7405-ENG-26. 263p. NTIS, PC A12/MF A01.

Separate abstracts were prepared for 9 of the included sections. (MOW)

39138 (ORNL—5645, pp 177-188) **Engineering test facility design center.** Aug 1980.

In Fusion Energy Division annual progress report period ending December 31, 1979.

The vehicle by which the fusion program would move into the engineering testing phase of fusion power development is designated the Engineering Test Facility (ETF). The ETF would provide a test bed for reactor components in the fusion environment. In order to initiate preliminary planning for the ETF decision, the Office of Fusion Energy established the ETF Design Center activity to prepare the design of the ETF. This section describes the status of this design.

39139 (ORNL/TM—7122) **R and D needs assessment for the Engineering Test Facility.** (Oak Ridge National Lab., TN (USA)). Oct 1980. Contract W-7405-ENG-26. 203p. NTIS, PC A10/MF A01.

The Engineering Test Facility (ETF), planned to be the next major US magnetic fusion device, has its mission (1) to provide the capability for moving into the engineering phase of fusion development and (2) to provide a test-bed for reactor components in a fusion environment. The design, construction, and operation of the ETF requires an increasing emphasis on certain key research and development (R and D) programs in magnetic fusion in order to provide the necessary facility design base. This report identifies these needs and discusses the apparent inadequacies of the presently planned US program to meet them, commensurate with the ETF schedule.

39140 (PNL—2720) **Preconceptual design and assessment of a Tokamak Hybrid Reactor.** Teofilo, V.L.; Leonard, B.R. Jr.; Aase, D.T. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Sep 1980. Contract AC06-76RL01830. 201p. NTIS, PC A10/MF A01.

The preconceptual design of a commercial Tokamak Hybrid Reactor (THR) power plant has been performed. The tokamak fusion driver for this hybrid is operated in the ignition mode. The D-T fusion plasma, which produces 1140 MW of power, has a major radius of 5.4 m and a minor radius of 1.0 m with an elongation of 2.0. Double null poloidal divertors are assumed for impurity control. The confining toroidal field is maintained by D-shaped Nb_3Sn superconducting magnets with a maximum field of 12T at the coil. Three blankets with four associated fuel cycle alternatives have been combined with the ignited tokamak fusion driver. The engineering, material, and balance of plant design requirements for the THR are briefly described. Estimates of the capital, operating and maintenance, and fuel cycle costs have been made for the various driver/blanket combinations and an assessment of the market penetrability of hybrid systems is presented. An analysis has been made of the nonproliferation aspects of the hybrid and its associated fuel cycles relative to fission reactors. The current and required level of technology for both the fusion and fission components of the hybrid system has been reviewed. Licensing hybrid systems is also considered.

39141 (UCAR—10042-80) **National mirror fusion program plan.** (California Univ., Livermore (USA). Lawrence Livermore Lab.; Department of Energy, Washington, DC (USA). Office of Fusion Energy). Jan 1980. Contract W-7405-ENG-48. 129p. NTIS, PC A07/MF A01.

Experiments are under way in the Tandem Mirror Experiment (TMX) facility at Livermore, which was built to test the principles of the new tandem-mirror concept. Recently this idea has been greatly improved by incorporating a new element called the thermal barrier, a concept that promises a higher power gain factor (Q = 10 to 20) with much less demanding neutral-beam and magnet technology and a higher fusion power density in the reactor. In addition to the tandem-mirror experiments in TMX, a new attempt will be made in the Beta II facility during FY 1980 to create and sustain a field-reversed mirror configuration, which is a different mirror fusion approach that could lead to early commercialization of small reactors. The plan presented here is designed to exploit the results of these and other mirror experiments and theoretical developments toward a variety of applications. The main objective is electric power generation. Other applications being studied include a hybrid fusion reactor that breeds fuel for fission reactors and a reactor for producing synthetic fuel (H_2) by means of thermochemical processes.

39142 (UCID—18803) **Results of TMX operations: January-July 1980.** Correll, D.L.; Drake, R.P. (eds.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Sep 1980. Contract W-7405-ENG-48. 188p. NTIS, PC A09/MF A01.

This interim report summarizes results from the Tandem Mirror Experiment (TMX) during the period January to July 1980 and describes the physics experiments, the machine operation, and the diagnostics that were added to TMX during this period. This operating period followed the initial proof-of-principle TMX experiments and predated the ongoing final experiments preceding TMX shutdown for modification to TMX Upgrade. The results described in this report include measurements of plasma parameters and plasma behavior which confirm the initial TMX results that demonstrated that the tandem mirror configuration can be generated and sustained by neutral beam injection and that the tandem mirror configuration improves confinement of magnetic mirror systems.

39143 (UCRL—85002) **MFTF-progress and promise.** Thomassen, K.I. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 3 Oct 1980. Contract W-7405-ENG-48. 4p. (CONF-801011—7). NTIS, PC A02/MF A01.

From 4. ANS topical meeting on the technology of controlled nuclear fusion; King of Prussia, PA, USA (14 Oct 1980).

The Mirror Fusion Test Facility (MFTF) has been in construction at Lawrence Livermore National Laboratory (LLNL) for 3 years, and most of the major subsystems are nearing completion. Recently, the scope of this project was expanded to meet new objectives, principally to reach plasma conditions corresponding to energy break-even. To fulfill this promise, the single-cell minimum-B mirror configuration will be replaced with a tandem mirror configuration (MFTF-B). The facility must accordingly be expanded to accomodate the new geometry. This paper briefly discusses the status of the major MFTF subsystems and describes how most of the technological objectives of MFTF will be demonstrated before we install the additional systems necessary to make the tandem. It also summarizes the major features of the expanded facility.

BLANKET ENGINEERING

REFER ALSO TO CITATION(S) 38154

39144 (UCRL—84272) **Parametric analysis of stress in the ICF HYLIFE converter structure.** Hovingh, J.; Blink, J.A. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). Oct 1980. Contract W-7405-ENG-48. 11p. (CONF-801011—12). NTIS, PC A02/MF A01.

From 4. ANS topical meeting on the technology of controlled nuclear fusion; King of Prussia, PA, USA (14 Oct 1980).

The concept of a liquid-metal first wall in an ICF energy converter has a particularly attractive feature: the liquid metal absorbs the short-ranged fusion energy and moderates and attenuates the neutron energy so that the converter structure may have a lifetime similar to that of a conventional power plant. However, the sudden deposition of fusion energy in the liquid-metal first wall will result in disassembly of the liquid, which then impacts on the structure. The impact pressure on the structure is a strong function of the location and thickness of the liquid-metal first wall. The impact stress is determined by the impact pressure and duration and by the thickness and location of the structure. The maximum allowable stress is determined by the design stress criteria chosen by the structural designer. Scaling laws for the impact pressure as a function of the liquid-metal first wall location and mass are presented for a 2700 MW(f) (fusion power) plant with either one or four fusion reactor vessels. A methodology for determining the optimum combination of liquid-metal first wall geometry and first-structural-wall thickness is shown. Based on the methodology developed, a parametric analysis is presented of the liquid-metal flow rate and first-structural-wall requirements.

39145 (UCRL—84273) **Properties of lead-lithium solutions.** Hoffman, N.J.; Darnell, A.; Blink, J.A. (Energy Technology Engineering Center, Canoga Park, CA (USA); California Univ., Livermore (USA). Lawrence Livermore National Lab.). Oct 1980. Contract W-7405-ENG-48. 11p. (CONF-801011—9). NTIS, PC A02/MF A01.

From 4. ANS topical meeting on the technology of controlled nuclear fusion; King of Prussia, PA, USA (14 Oct 1980).

Lead-lithium solutions are of interest to liquid metal wall ICF reactor designers because Pb may be present to some extent in both heavy ion beam and laser-driven ICF targets; therefore, Pb will be present as an impurity in a flowing lithium wall. In addition, Pb-Li solutions containing ~ 80 a/o Pb are a strong candidate for a heavy ion beam driven HYLIFE converter and a viable alternative to a pure Li wall for a laser driven converter. The properties of Pb-Li solutions including the effect of hydrogen impurities are reviewed, and the reactor design implications are discussed.

MAGNET COILS AND FIELDS

REFER ALSO TO CITATION(S) 38201, 38526, 38527

39146 (CONF-800980—8) **Superconducting magnets for toroidal fusion reactors.** Haubenreich, P.N. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 7p. NTIS, PC A02/MF A01.

From Applied superconductivity conference; Santa Fe, NM, USA (29 Sep 1980).

Fusion reactors will soon be employing superconducting magnets to confine plasma in which deuterium and tritium (D-T) are fused to produce usable energy. At present there is one small confinement experiment with superconducting toroidal field (TF) coils: Tokamak 7 (T-7), in the USSR, which operates at 4 T. By 1983, six different 2.5 x 3.5-m D-shaped coils from six manufacturers in four countries will be assembled in a toroidal array in the Large Coil Test Facility (LCTF) at Oak Ridge National Laboratory (ORNL) for testing at fields up to 8 T. Soon afterwards ELMO Bumpy Torus (EBT-P) will begin operation at Oak Ridge with superconducting TF coils. At the same time there will be tokamaks with superconducting TF coils 2 to 3 m in diameter in the USSR and France. Toroidal field strength in these machines will range from 6 to 9 T. NbTi and Nb_3Sn, bath cooling and forced flow, cryostable and metastable - various designs are being tried in this period when this new application of superconductivity is growing and maturing.

39147 (CONF-801011—10) **Configurational analysis of an EBT reactor in various magnetic geometries.** Owen, L.W.; Uckan, N.A. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 13p. NTIS, PC A02/MF A01.

From 4. ANS topical meeting on the technology of controlled nuclear fusion; King of Prussia, PA, USA (14 Oct 1980).

Optimization of vacuum field particle confinement in an ELMO Bumpy Torus (EBT) reactor has been considered. Several methods of improving the efficient utilization of magnetic fields and the particle confinement characteristics of a reactor have been analyzed. These include the use of (1) magnets with a large mirror ratio, (2) high field Nb_3Sn or Nb_3Sn/NbTi hybrid mirror coils, (3) split-wedge mirror coils, (4) aspect ratio enhancement (ARE) coils, and (5) recently developed field symmetrizing (SYM) coils. Of these, particle drift orbits and three-dimensional tensor pressure equilibrium calculations have shown that the ARE and SYM coils used in conjunction with high field magnets offer the most promise of good plasma performance in a smaller size (up to 50%) EBT reactor. The relative merits of each magnetic configuration are discussed, and the design characteristics are given.

39148 (COO—2218-183) **Radial electric fields from larmor radius effects in the field-reversed θ pinch.** Hu, Y. (Illinois Univ., Urbana (USA). Fusion Studies Lab.). 1980. Contract AS02-76ET52040. 41p. NTIS, PC A03/MF A01.

Thesis.

The generation of radial electric field from the different Larmor radii between the diffusing ions and electrons in Field-Reversed Theta Pinch (FR θ P) has been evaluated by developing a new computer code, FLR. The code treats the background electrons at point particles, while for large-orbit ions the effects of finite Larmor radius are incorporated into an accurate density formulation. This is necessary since in a small device whose size is comparable to an ion gyroradius (e.g., FR θ P) most ions will contribute to the density over a fairly large region of the plasma. The actual ion density at any point in the plasma represents a time-averaged contribution from all particles whose gyro-orbits pass through that point. The FLR code has predicted the electric field strengths between 10^3 and 10^4 volts/cm, which is in good agreement with the experimental values of FRX-A measurements which correspond roughly to the order of 10^3 volts/cm.

39149 (GA-A—15974) **Team one (GA/MCA) effort of the DOE 12 Tesla Coil Development Program. 12 Tesla ETF toroidal field coil helium bath cooled NbTi alloy concept.** (General Atomic Co., San Diego, CA (USA)). Jul 1980. Contract AT03-76ET51011. 93p. NTIS, PC A05/MF A01.

This report presents the conceptual design of an ETF compatible toroidal field coil, employing helium bath cooled NbTi alloy conductor. The ten TF-coil array generates a peak field of 11-1/2 tesla at 2.87 m radius, corresponding to a major axis field of 6.1 tesla. The 10 kA conductor is an uninsulated, unsoldered Rutherford cable, employing NbTiTa ally as developed in Phase I of this effort. The conductor is encased within a four element frame of stainless steel strips to provide hoop and bearing load support.

39150 (GA-A—16012) **Measurement of stability of cabled conductors cooled by He I at reduced temperature, or He II.** Hsu, Y.H.; Purcell, J.R.; Chen, W.Y.; Alcorn, J.S. (General Atomic Co., San Diego, CA (USA)). Sep 1980. Contract AT03-76ET51011. 5p. (CONF-800980—13). NTIS, PC A02/MF A01.

From Applied superconductivity conference; Santa Fe, NM, USA (29 Sep 1980).

Stability tests of cabled NbTi alloy conductor are underway at the General Atomic High Field Test Facility, in support of the Team One effort of the DOE 12 Tesla Coil Development Program. A background field of up to 10 tesla within a 20 cm bore is provided by a nested pair of 4.2°K bath cooled NbTi coils. An insulated bore insert tube (coldfinger) is provided in order to perform heat pulse/recovery tests of coiled samples in cooling regimes anticipated for the 1 m O.D. coil to be tested at the LLNL 12 tesla facility during FY 82. Specifically, tests are being performed in the 2.5 to 3°K He I, and saturated superfluid (He II) regimes. The testing apparatus, procedures, and initial results are presented.

39151 (GA-A—16013) **Stability analysis of NbTi-Ta-based high field conductor cooled by pool boiling below 4 K.** Chen, W.Y.; Alcorn, J.S.; Hsu, Y.H.; Purcell, J.R. (General Atomic Co., San Diego, CA (USA)). Sep 1980. Contract AT03-76ET51011. 7p. (CONF-800980—15). NTIS, PC A02/MF A01.

From Applied superconductivity conference; Santa Fe, NM, USA (29 Sep 1980).

Stability analysis has been performed for cabled NbTi-Ta-based superconductors intended for the high field (12 T) toroidal field coils for a large scale tokamak device such as ETF. Ternary NbTi-Ta was selected as the superconductor because of its superior critical current density at high field as compared to the binary alloy NbTi. The operating temperature was chosen to be 2.5 K or below to optimize the performance of the superconductor. A cabled conductor was selected to minimize the pulsed field losses. The conductor is cooled by pool boiling in a subcooled (~ 2.5 K, 0.25 atm) bath, or in a superfluid helium (He-II) bath (~ 1.8 K, 0.02 atm). The analysis was based on numerically simulating the evolution of a normal zone in the conductor. Appropriate superconductor properties and heat transfer characteristics were utilized in the simulation.

39152 (GA-A—16014) **Status of the GA/MCA 12 Tesla Coil Development Program.** Alcorn, J.S.; Purcell, J.R.; Chen, W.Y.; Hsu, Y.H. (General Atomic Co., San Diego, CA (USA)). Sep 1980. Contract AT03-76ET51011. 6p. (CONF-800980—14). NTIS, PC A02/MF A01.

From Applied superconductivity conference; Santa Fe, NM, USA (29 Sep 1980).

The current status of the Team One effort of the DOE/OFE/D and T 12 Tesla Coil Development Program is presented. Subatmospheric, helium bath cooled, NbTiTa alloy is employed for the test coil, and ETF TF-coil concept. General Atomic is the Team One leader, with Magnetic Corporation of American as industrial subcontractor.

39153 (LA—8516-MS) **RMF concept: a rotating-magnetic-field technique for driving steady plasma currents in compact toroid devices.** McKenna, K.F. (Los Alamos Scientific Lab., NM (USA)). Sep 1980. Contract W-7405-ENG-36. 34p. NTIS, PC A03/MF A01.

The generation and/or sustaining of a Compact Toroid (CT) configuration using the RMF technique is a relatively new and unknown concept. In this report the basic principles, historical development, and current theoretical understanding of this concept are reviewed. Significant experimental and theoretical results, potential problem areas, and recommendations for the direction of future work are discussed. An illustrative analysis of the application of the RMF technique to a CT reactor is presented. The results of a recent experiment, the Rotamak, in which a Spheromak-like CT plasma was produced using the RMF technique, are presented.

39154 (LA-UR—80-2742) **Superconductor design and loss analysis for a 20 MJ induction heating coil.** Walker, M.S.; Declercq, J.G.; Zeitlin, B.A. (Los Alamos Scientific Lab., NM (USA); Intermagnetics General Corp., Guilderland, NY (USA); Westinghouse Electric Corp., Pittsburgh, PA (USA)). 1980. Contract W-7405-ENG-36. 22p. (CONF-800980—6). NTIS, PC A02/MF A01.

From Applied superconductivity conference; Santa Fe, NM, USA (29 Sep 1980).

The design of a 50 k Ampere conductor for use in a 20 MJ Induction Heating Coil is described. The conductor is a wide flat cable of 36 subcables, each of which contains six NbTi strands around a stainless steel core strand. The 2.04 mm (0.080″) diameter monolithic strands allow bubble clearing for cryostable operation at a pool boiling heat transfer from the unoccluded strand surface of 0.26 Watts/cm^2. A thin, tough polyester amide-imide (Westinghouse Omega) insulation provides a rugged coating that will resist flaking and chipping during the cabling and compaction operations and provide (1) a reliable adherent surface for enhanced heat transfer, and (2) a low voltage standoff preventing interstrand coupling losses. The strands are uniquely configured using CuNi elements to provide low ac losses with NbTi filaments in an all-copper matrix. AC losses are expected to be approximately 0.3% of 20 MJ for a -7.5 T to 7.5 T one-second 1/2-cosinusoidal bipolar operation in a 20 MJ coil. They will be approximately 0.1% of 100 MJ for 1.8 second -8 T and +8 T ramped operation in a 100 MJ coil. The design is firmly based on the results of tests performed on prototype strands and subcables.

39155 (ORNL—5645, pp 155-175) **Superconducting magnet development.** Aug 1980.

In Fusion Energy Division annual progress report period ending December 31, 1979.

Work in the Magnetics and Superconductivity Section fell into four categories: (1) research and development in support of the LCP; (2) two 12-T coil projects involving industries; (3) advanced conductor development; and (4) specific magnet designs. Notable progress was made in each of these areas.

39156 (ORNL/TM—7339) **Equilibrium field coils for the Engineering Test Facility: shaping the plasma cross section.** Strickler, D.J.; Peng, Y.K.M. (Oak Ridge National Lab., TN (USA)). Sep 1980. Contract W-7405-ENG-26. 29p. NTIS, PC A03/MF A01.

Through programming of currents, a relatively simple set of equilibrium field (EF) coils located exterior to the toroidal field (TF) coils will create the external field necessary to fix the plasma shape during different phases of the plasma discharge. The method of coil location is described and applied to a preconceptual ETF/INTOR tokamak design of 12 TF coils and a poloidal divertor. Free-boundary MHD equilibrium calculations using the EF coil configuration show that the position of the separatrix changes by about 10 cm as plasma pressure increases from $\beta = 0.5\%$ to $\beta = 5.6\%$. We have attempted to satisfy the present perception of plasma equilibrium requirements and engineering constraints in ETF and INTOR.

39157 (PPPL—1707) **Disruptive shift of magnetic axis in non-circular tokamaks.** Okabayashi, M.; Maeda, H.; Takahashi, H.; Reusch, M. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Sep 1980. Contract AM02-76CH03073. 14p. NTIS, PC A02/MF A01.

The magnitude of magnetic axis shift, following a sudden, disruptive decrease in internal inductance and poloidal β, can be greatly reduced in non-circular tokamaks by exploiting the negative decay index of the equilibrium magnetic field. In this sense a non-circular plasma has important advantages over a circular plasma in preventing the catastrophic consequences of major disruptions. A tokamak design and operational concept is discussed, which exploits these advantages, and is fundamentally different from the traditional approach.

HEATING AND FUELING SYSTEMS

39158 (CONF-800427—19(Draft)) **Implications of tritium in neutral beam injectors.** Kim, J.; Stewart, L.D. (Oak Ridge National Lab., TN (USA); Exxon Nuclear Co., Inc., Bellevue, WA (USA)). 1980. Contract W-7405-ENG-26. 14p. NTIS, PC A02/MF A01.

From Tritium technology in fission, fusion, and isotopic applications; Dayton, OH, USA (29 Apr 1980).

Neutral injectors for heating plasmas of D-T burning fusion reactors are subject to tritium contamination. This paper discusses relevant questions and problem areas pertinent to tritium environment, including calculations of tritium contaminations in different neutral injectors, gas handling and pumping systems, and implications on beam line components.

39159 (CONF-800455—20(Draft)) **Hydrogen recycle modeling and measurements in tokamaks and EBT.** Howe, H.C. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). 1980. Contract W-7405-ENG-26. 30p. NTIS, PC A03/MF A01.

From 4. international conference on plasma surface interactions in controlled fusion devices; Garmisch, F.R. Germany (21 Apr 1980).

A model for hydrogen recycling developed for use in a Tokamak transport code is described and compared with measurements on ISXB and DITE. The model includes kinetic reflection of charge-exchange neutrals from the wall and deposition, thermal diffusion and desorption processes in the wall. In a Tokamak with a limiter, the inferred recycle coefficient of 0.9 to 1.0 is due primarily to reflection (0.8 to 0.9) with the remainder (0.1 to 0.2) being due to desorption. Laboratory experiments supply much of the data for the model and several areas are discussed where additional data are needed, such as reflection from hydrogen-loaded walls at low (~ 100 eV) energy. Simulation of ISXB shows that the recently observed density decrease with neutral beam injection may be partially due to a decrease in recycling caused by hardening of the charge-exchange flux incident on the wall from the plasma. Modeling of isotopic exchange in DITE indicates the need for an ion-induced desorption process which responds on a timescale shorter than the wall thermal diffusion time.

39160 (CONF-801011—11(Draft)) **Plasma physics sensitivity analysis of catalyzed-d operation in tokamaks.** Attenberger, S.E.; Houlberg, W.A. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 6p. NTIS, PC A02/MF A01.

From 4. ANS topical meeting on the technology of controlled nuclear fusion; King of Prussia, PA, USA (14 Oct 1980).

A state-of-the-art physics analysis was performed of the feasibility of a self-sufficient, reasonably small, moderate β, catalyzed-D tokamak reactor. The WHIST 1-D transport code is used to investigate the sensitivity of our model to various physics assumptions, including ^{3}He refueling, confinement of the 14.7 MeV protons from the D-^{3}He reaction, toroidal field ripple, and synchrotron radiation losses. We find that such a power plant requires an extremely efficient refueling system for ^{3}He. Many of the arguments presented here apply to all closed confinement systems.

39161 (ORNL—5645, pp 139-154) **Plasma heating and fueling.** Aug 1980.

In Fusion Energy Division annual progress report period ending December 31, 1979.

The Plasma Technology Section is principally concerned with: (1) development of multimegawatt neutral beam lines, including electrical systems and vacuum pumping, for plasma heating; and (2) development of techniques to fuel the plasma using high-velocity pellets.

39162 (ORNL/TM—7124(Draft)) **Deuterium and tritium fueling in an ETF/INTOR plasma with divertor.** Houlberg, W.A.; Howe, H.C.; Attenberger, S.E. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 37p. (CONF-800874—1(Draft)). NTIS, PC A03/MF A01.

From Varenna workshop on physics of plasmas close to thermonuclear conditions; Varenna, Italy (27 Aug 1980).

Fueling by pellets and neutral gas in the presence of a divertor is examined with a one-dimensional multispecies transport code. Deuterium, tritium, and alpha particles are treated as independent thermal species. With an efficiently operating divertor, it becomes impossible to maintain high plasma density (anti n ~ 10^{14}cm^{-3}) with neutral gas fueling alone because of the high probability of the gas being ionized in the scrapeoff layer. Pellet fueling significantly reduces the particle load on the divertor and, with feedback control, can maintain the plasma density at the desired level. A low level of deuterium gas fueling can then be used to maintain the density of the scrapeoff layer and increase shielding against sputtered impurities. Even with an effective shielding divertor, the energy and particle fluxes to the first wall from both charged and neutral particles may be significant. The fluctuations at the plasma edge and in the scrapeoff layer introduced by the pellets cause the particle and energy fluxes to the divertor and first wall to

fluctuate. This makes simulation more difficult but may be used to experimentally determine radial and parallel transport properties in the scrapeoff layer. Recommendations for further study are made.

39163 (UCRL—84888) **Negative deuterium ions for tandem mirror next step and tandem mirror reactors.** Hamilton, G.W. (Brookhaven National Lab., Upton, NY (USA)). 25 Sep 1980. Contract W-7405-ENG-48. 9p. (CONF-801068—2). NTIS, PC A02/MF A01.

From 2. international symposium on the production and neutralization of negative hydrogen ions and beams; Upton, NY, USA (6 Oct 1980).

Recent designs for mirror fusion reactors with good power balance include ambipolar potential plugs to reduce end losses and thermal barriers to maintain a difference in electron temperature between the large-volume central cell plasma and the confining end plugs. These designs led to several new requirements for D^0 neutral beams derived from negative ions at energies of 150 to 200 keV and possibly higher. Such beams are required for injection of fat ions into the plugs and the barrier and for charge-exchange pumping of thermal ions diffusing into the barrier. Negative ions are preferred for these purposes because of their relatively high efficiency of neutralization and their high purity of single-energy D^-. Examples of injector designs for Tandem Mirror Next Step (TMNS) and Tandem Mirror Reactors (TMR) are presented.

TRITIUM PROCESSING, ENVIRONMENT AND SAFETY

39164 (DOE/ER/10087—T2) **Investigation of non-magnetic alloys for the suppression of tritium permeation.** (Thermacore, Inc., Lancaster, PA (USA)). Jul 1980. Contract AC05-79ER10087. 54p. NTIS, PC A04/MF A01.

The present work was aimed at identification of alloys which might combine low tritium permeation with other properties desired in fusion reactor vessels, heat exchangers, lithium-handling plumbing and other components likely to contain tritium. These properties include low radiation damage, low magnetic permeability, high temperature strength, and compatibility with potential heat transfer and blanket materials. The work consisted of two tasks: problem definition, and literature search and analysis. Task I was complicated by the incomplete status of fusion reactor development, particularly with respect to selection of coolant and blanket materials and temperatures. The approach taken was to establish a probable range of requirements.

39165 (PNL—3487) **Transport and deposition of activation products in a helium cooled fusion power plant.** Bickford, W.E. (Battelle Pacific Northwest Labs., Richland, WA (USA)). Sep 1980. Contract AC06-76RL01830. 59p. NTIS, PC A04/MF A01.

The transport and deposition of neutron activation products in a helium cooled tokamak fusion power plant are investigated. Stainless steel is used as coolant channel material for a helium/steam system. The important gamma emitting nuclides ^{56}Mn, ^{54}Mn, ^{57}Co, ^{58}Co, ^{60}Co, ^{51}Cr, and ^{99}Mo are considered. The dominant release mechanism identified is direct daughter recoil emission from (n,x) type reactions. Corrosion and evaporation are discussed. The radionuclide inventory released by these mechanisms is predicted to exceed 1×10^4 Ci for a reference reactor design after only several days of operation, and approach 3.5×10^4 Ci in equilibrium. A mass transport model is then used to predict the deposition pattern of this inventory in the reactor cooling system.

POWER CONVERSION SYSTEMS

39166 (UCRL—84235) **Technology of direct conversion for mirror reactor end-loss plasma.** Barr, W.L.; Moir, R.W. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 7 Oct 1980. Contract W-7405-ENG-48. 11p. (CONF-801011—6). NTIS, PC A02/MF A01.

From 4. ANS topical meeting on the technology of controlled nuclear fusion; King of Prussia, PA, USA (14 Oct 1980).

Design concepts are presented for plasma direct convertors (PDC) intended primarily for use on the end-loss plasma from tandem-mirror reactors. Recent experimental results confirm most of these design concepts. Both a one-stage and a two-stage PDC were tested in reactor-like conditions using a 100-kV, 6-kW ion beam. In a separate test on the end of the TMX machine, a single stage PDC recovered 79 W for a net efficiency of 50%. Tandem mirror devices are well suited to PDC. The high minimum energy of the end-loss ions, the magnetic expansion outside the mirrors, and the vacuum conditions in the end tanks required by the confined plasma, all preexist. The inclusion of a PDC is therefore a rather small addition. These facts and the scale parameters for a PDC are discussed.

INERTIAL CONFINEMENT TECHNOLOGY

REFER ALSO TO CITATION(S) 38536, 38570, 38571, 38572, 38573, 38574, 38575, 38576, 38577, 38578, 38579, 38580, 38581, 38582, 38583, 38586, 38587, 38588, 38589, 38590, 38591, 38592, 38593, 38594, 38595, 38599, 38600, 38601, 38602, 38603, 38604, 38605

39167 (CONF-800208—21) **Transport inhibition due to flow-driven ion turbulence at the shock behind the critical surface.** Mayer, F.J.; Mitrovich, D.; Powers, L.V.; Speziale, T. (KMS Fusion, Inc., Ann Arbor, MI (USA)). 1980. Contract AC08-78DP40030. 7p. NTIS, PC A02/MF A01.

From Topical meeting on inertial confinement fusion; San Diego, CA, USA (26 Feb 1980).

Using a fine-zoned spherical hydrodynamic code, we examine the effects of reduced thermal conductivity at the ion acoustic shock behind the ponderomotive force-steepened profile. Narrow, high density peaks, and shock heated ions are found.

39168 (LBL—10301, pp 1-5) **Heavy ion accelerator study session.** Herrmannsfeldt, W.B. (Stanford Linear Accelerator Center, CA). Sep 1980.

From Heavy ion fusion workshop; Berkeley, CA, USA (29 Oct 1979).

The physics of high-intensity heavy-ion accelerators was studied in order to assess their promise as ignitor systems for inertially confined fusion.

39169 (LBL—10301, pp 14-20) **ANL low beta development (Phase 0).** Watson, J.M. (Argonne National Lab., IL). Sep 1980.

From Heavy ion fusion workshop; Berkeley, CA, USA (29 Oct 1979).

The HIF group at Argonne National Laboratory is currently developing the initial Accelerator Demonstration Facility (ADF) for the rf linac reference concepts. This has been dubbed Phase 0 since it is a preliminary step before our two proposed ADF's which could deposit 10 kJ (Phase I) and 500 kJ (Phase II) on target. Phase 0 is a $25 million project over a three-year period. Unfortunately, much of the funding expected for this project was withdrawn from the FY 1980 budget, thereby delaying its completion by a year.

39170 (LBL—10301, pp 27-34) **Beam brightness in low beta linacs: a sensitivity study.** Burke, R.J. (Argonne National Lab., IL); Sacks, R.A. Sep 1980.

From Heavy ion fusion workshop; Berkeley, CA, USA (29 Oct 1979).

The results are presented of a numerical study aimed at gaining an engineering characterization of the dependence of the accelerated beam quality and intensity on various parameters in the linac design, the initial beam configuration, and the initial current. A dramatic improvement is observed when injection energy is raised, and some tentative suggestions are offered for techniques of achieving this increase.

39171 (LBL—10301, pp 63-67) **Linac summary.** Penner, S.; Wilson, M. Sep 1980.

From Heavy ion fusion workshop; Berkeley, CA, USA (29 Oct 1979).

To define the problem areas for both the rf and induction linac scenarios. We are not addressing engineering or cost considerations. We also did not consider the test beds.

39172 (LBL—10301, pp 315-326) **Longitudinal beam stability in heavy ion storage rings.** Mohl, D. (CERN, Geneva, Switzerland). Sep 1980.

From Heavy ion fusion workshop; Berkeley, CA, USA (29 Oct 1979).

This is an attempt to scale conditions for longitudinal beam stability to heavy ion storage rings (HIS) which have been proposed as part of some accelerator schemes to drive pellet fusion. The instability considered has been observed in many high intensity proton machines. In the CERN 25 GeV Proton Synchrotron (PS), this can occur near transition energy as well as during debunching at high energy. In the 30 GeV intersecting storage rings (ISR) similar effects happen to the newly injected beam when too many dense bunches are transferred. In all these cases the instability manifests itself by a rapid blow-up of the beam momentum spread and this blow-up is accompanied by rf activity observed on beam current pick-up electrodes at frequencies in the, say, 0.3 to 2 GHz region.

39173 (LBL—10301, pp 426-441) **Light ion fusion experiment (LIFE) accelerator system for ICF.** Guiragossian, Z.G.T. (TRW Defense and Space Systems Group, Redondo Beach, CA). Sep 1980.

From Heavy ion fusion workshop; Berkeley, CA, USA (29 Oct 1979).

A Light Ion Fusion Experiment (LIFE) accelerator system is under study as a driver for ICF. The system consists of separate functional elements. Light ions are extracted from a pulsed cold plasma source and accelerated in multi-grid and multi-aperture accel-

erator structures, with provision for strong compression of beam pulses. D or He ion beams, 20 kA, 1 to 10 MeV, will be made to ballistically propagate in 10^{-4} torr gas by externally generated comoving electrons which provide space-charge and current neutralization. The propagation method is relevant to the Heavy Ion Fusion program and helps to reduce the large number of heavy ion beams entering a reactor to a manageable few. The system is also a useful test bed to perform several propagation experiments in the near term. The reactor requirements in Heavy Ion Fusion and LIFE are identical.

39174 (NRL-MR—4319) **Doppler velocimeter for laser accelerated targets.** Obenschain, S.P.; McLean, E.A.; Gold, S.H. (Naval Research Lab., Washington, DC (USA)). 28 Aug 1980. Contract AI01-77DP40042. 14p. NTIS, PC A14/MF A01.

A doppler velocimeter utilizing a spectrograph and a short pulse laser probe is described which provides good spatial (20 μm) and subnanosecond temporal resolution. This system has been used to measure the velocity profiles of targets ablatively accelerated to very high velocities by a high power laser beam. A unique aspect of this velocimeter is that the doppler wavelength shifts are measured directly rather than employing interferometric techniques.

39175 (SAND—79-1944) **Particle beam fusion progress report January 1979 through June 1979.** (Sandia National Labs., Albuquerque, NM (USA)). Oct 1980. Contract AC04-76DP00789. 205p. NTIS, PC A10/MF A01.

The following chapters are included: (1) fusion target studies, (2) target experiments, (3) particle beam source development, (4) particle beam experiments, (5) pulsed power research and development, (6) pulsed fusion applications, and (7) electron beam fusion accelerator project. (MOW)

39176 (UCID—18793) **Nova chain design and performance.** Simmons, W.W.; Glaze, J.A.; Trenholme, J.B.; Hagen, W.F. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 4 Sep 1980. Contract W-7405-ENG-48. 36p. NTIS, PC A03/MF A01.

During the past year design of the Nova laser has undergone significant change as a result of developments in our laser glass and optical coating evaluation programs. Two notable aspects of the glass development program deserve emphasis. First, vendor qualification for production of fluorophosphate laser glass is progressing satisfactorily. There is a reasonable expectation that vendors can meet fluorophosphate glass specifications within Nova schedule constraints. Secondly, recent gain saturation measurements have shown that the saturation fluence of the fluorophosphate glass is larger than previously supposed ($\sim$ 5.5 J/cm^2) and in fact is somewhat larger than Shiva silicate glasses. Hence, performance of Nova for pulses in the 3 ns and longer range should be satisfactory. For pulses in the 1 ns regime, of course, the fluorophosphate chain will have superior performance to that of silicate because of its low nonlinear index of refraction ($\sim$ 30% that of silicate). These and other considerations have led us to choose a chain design based upon the use of fluorophosphate glass in our amplifiers.

39177 (UCRL—52957) **Introduction to Praxis.** Greenwood, J.R.; Evans, A. Jr.; Morgan, C.R.; Zarnstorff, M.C. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). Jul 1980. Contract W-7405-ENG-48. 32p. NTIS, PC A03/MF A01.

Praxis is the practice of the programming art, science, and skill. It is a high-order language designed for the efficient programming of control and systems applications. It is a comprehensive, strongly typed, block-structured language in the tradition of Pascal, with much of the power of the Mesa and Ada languages. It supports the development of systems composed of separately compiled modules, user-defined data types, exception handling, detailed control mechanisms, and encapsulated data and routines. Direct access to machine facilities, efficient bit manipulation, and interlocked critical regions are provided within Praxis.

39178 (UCRL—84271) **Consistent HYLIFE wall design that withstands transient loading conditions.** Pitts, J.H. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). Oct 1980. Contract W-7405-ENG-48. 9p. (CONF-801011—4). NTIS, PC A02/MF A01.

From 4. ANS topical meeting on the technology of controlled nuclear fusion; King of Prussia, PA, USA (14 Oct 1980).

The design for a first structural wall (FSW) promises to satisfy the impact and thermal stress loads for the 30-year lifetime anticipated for the HYLIFE reaction chamber. The FSW is a 50-mm-thick cylindrical plate that is 10 m in diameter; it can withstand a rapidly varying liquid metal impact stress up to a peak of 60 MPa, combined with slowly varying thermal stresses up to 86 MPa. We selected 2 1/4 Cr-1 Mo ferritic steel as the structural material because it has adequate fatigue properties and yield strength at the peak operating temperature of 810°K, is compatible with liquid lithium, and has good neutron activation characteristics.

39179 (UCRL—84275) **ICF ETF and its engineering development requirements.** Blink, J.A.; Allen, W.O.; Billman, K. (California Univ., Livermore (USA). Lawrence Livermore National Lab.; Bechtel National, Inc., San Francisco, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA); Sandia National Labs., Albuquerque, NM (USA)). Oct 1980. Contract W-7405-ENG-48. 9p. (CONF-801011—8). NTIS, PC A02/MF A01.

From 4. ANS topical meeting on the technology of controlled nuclear fusion; King of Prussia, PA, USA (14 Oct 1980).

Inertial confinement fusion driver development and ICF target physics are being intensively explored both theoretically and experimentally. However, engineering considerations of harnessing the fusion energy pulses that are an ultimate product and goal of the ICF physics program are only being addressed on a small scale. Experience with development of other new technologies indicates that engineering development time will be substantial for ICF energy converters. The authors met at Livermore in July 1980 to form an ICF Reactor Technology Working Group to address this issue. This paper outlines the current state of planning for an ICF Engineering Test Facility (ETF) and the engineering development that must precede it.

39180 (UCRL—84903) **Shiva automatic pinhole alignment.** Suski, G.J. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 5 Sep 1980. Contract W-7405-ENG-48. 29p. (CONF-801121—1). NTIS, PC A03/MF A01.

From 1980 fall DECUS US symposium; San Diego, CA, USA (4 Nov 1980).

This paper describes a computer controlled closed loop alignment subsystem for Shiva, which represents the first use of video sensors for large laser alignment at LLNL. The techniques used on this now operational subsystem are serving as the basis for all closed loop alignment on Nova, the 200 terawatt successor to Shiva.

COMPONENT DEVELOPMENT AND MATERIALS TESTING

39181 (CONF-800455—21) **Role of gas pressure and lateral stress on blistering.** Wolfer, W.G. (Wisconsin Univ., Madison (USA). Dept. of Nuclear Engineering). Apr 1980. Contract AS0-78ER04861. 25p. NTIS, PC A02/MF A01.

From 4. international conference on plasma surface interactions in controlled fusion devices; Garmisch, F.R. Germany (21 Apr 1980).

Both gas pressure in bubbles and lateral stress have been suggested as primary causes of blistering. An analysis of both mechanisms is presented, and the conditions for blistering are examined. To realistically predict the gas pressure in bubbles, a recently derived high-density equation of state for helium is utilized.

39182 (CONF-801011—3) **ORNL fusion reactor shielding integral experiments.** Santoro, R.T.; Alsmiller, R.G. Jr.; Barnes, J.M.; Chapman, G.T. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 6p. NTIS, PC A02/MF A01.

From 4. ANS topical meeting on the technology of controlled nuclear fusion; King of Prussia, PA, USA (14 Oct 1980).

Integral experiments that measure the neutron and gamma-ray energy spectra resulting from the attenuation of $\sim$ 14 MeV T(D,n) ^{4}He reaction neutrons in laminated slabs of stainless steel type 304, borated polyethylene, and a tungsten alloy (Hevimet) and from neutrons streaming through a 30-cm-diameter iron duct (L/D = 3) imbedded in a concrete shield have been performed. The facility, the NE-213 liquid scintillator detector system, and the experimental techniques used to obtain the measured data are described. The two-dimensional discrete ordinates radiation transport codes, calculational models, and nuclear data used in the analysis of the experiments are reviewed.

39183 (COO—2218-182) **Design considerations for a steady state fusion reactor's thermal energy dump (TED) with emphasis on SAFFIRE.** Werley, K.A. (Illinois Univ., Urbana (USA). Fusion Studies Lab.). 1980. Contract AS02-76ET52040. 143p. NTIS, PC A07/MF A01.

Thesis.

This work examines the use of a thermal dump to handle the severe particle and energy handling requirements of a diverted plasma. We outline a general approach for evaluating the design parameters and limitations of a thermal dump, considering such things as thermomechanical and erosion effects, compatibility, availability, machinability, coolant recirculation, vacuum pumping, economics, lifetime, etc. To demonstrate how the performance requirements are reflected in design decisions, we apply a solid-walled dump to a small-sized field reversed mirror (FRM). We also examine a liquid-lithium droplet thermal dump and point out some distinct advantages of this new concept over the solid-wall design in reducing stress, erosion, and vacuum pumping problems. The chief disadvantages of this scheme include liquid-metal safe-handling problems, vapor pressure-temperature limitations, and the need for differential pumping if T/sub Li/ > 310°C is desired.

39184 (DOE/ER—0046/2) **Damage analysis and fundamental studies. Quarterly progress report, April-June 1980.** (Hanford Engineering Development Lab., Richland, WA (USA)). Aug 1980. Contract AC14-76FF02170. 141p. NTIS, PC A07/MF A01.

The DAFS program element is a national effort composed of contributions from a number of National Laboratories and other government laboratories, universities, and industrial laboratories. It was organized by the Materials and Radiation Effects Branch, Office of Fusion Energy, DOE, and a Task Group on Damage Analysis and Fundamental Studies which operates under the auspices of that Branch. The purpose of this series of reports is to provide a working technical record of that effort for the use of the program participants, for the fusion energy program in general, and for the Department of Energy. This report is organized along topical lines in parallel to a Program Plan of the same title so that activities and accomplishments may be followed readily, relative to that Program Plan.

39185 (DOE/ER/10087—T1) **Investigation of non-magnetic alloys for the suppression of tritium permeation. Final report.** (Thermacore, Inc., Lancaster, PA (USA)). Jul 1980. Contract AC05-79ER10087. 53p. NTIS, PC A04/MF A01.

This report describes a small (300 man hour) literature survey relating to the suppression of tritium loss by permeation through the walls of fusion reactors. The program was based on prior in-house Thermacore work to suppress hydrogen permeation into high temperature (800°C) heat pipes. The Thermacore approach involves selection of a steel with a small (.5 to 5%) aluminum content. The aluminum is diffused to the surface and oxidized. The present work was aimed at identification of alloys which might combine low tritium permeation with other properties desired in fusion reactor vessels, heat exchangers, lithium-handling plumbing and other components likely to contain tritium. These properties include low radiation damage, low magnetic permeability, high temperature strength, and compatibility with potential heat transfer and blanket materials. The work consisted of two tasks: Problem Definition and Literature Search and Analysis.

39186 (ORNL—5645, pp 189-201) **Materials.** Aug 1980.

In Fusion Energy Division annual progress report period ending December 31, 1979.

The primary purpose of the materials work for fusion at Oak Ridge National Laboratory (ORNL) is to develop a suitable near-term structural alloy for the Engineering Test Facility (ETF) and more advanced alloys for commercial fusion reactors. Two classes of alloys, austenitic stainless steels and ferritic steels, are being evaluated for the ETF. For commerical fusion reactors, these same classes of alloys are being considered as are the higher-strength iron-nickel-chromium alloys; vanadium, niobium, and titanium alloys; and the long-range-ordered alloys based on the system $(Fe,Ni)_3V$.

39187 (ORNL—5645, pp 203-212) **Neutron transport.** Aug 1980.

In Fusion Energy Division annual progress report period ending December 31, 1979.

The neutron transport program includes both experimental and analytic phases. The experimental program is designed to provide: (1) data necessary for verifying the analytic methods; and (2) cross-section data used at the Oak Ridge National Laboratory (ORNL) and throughout the United States for fusion reactor neutronics design calculations. Experiments are being carried out to determine the neutron transport in typical fusion reactor shield materials and configurations and to determine the effects of penetrations in these shields. The analytic program supports the design of the integral experiments and compares calculated data with data obtained experimentally. Neutronics calculations have also been carried out in support of the design of the Tokamak Fusion Test Reactor (TFTR) being built at Princeton University. The Radiation Shielding Information Center (RSIC) has continued to supply a broad range of servies to the fusion energy research community.

39188 (ORNL/TM—7153) **Instrumentation and controls of an ignited toksmak.** Becraft, W.R.; Golzy, J.; Houlberg, W.A.; Kukielka, C.A.; Onega R.J.; Raju, G.V.S.; Stone, R.S. (Oak Ridge National Lab., TN (USA)). Oct 1980. Contract W-7405-ENG-26. 136p. NTIS, PC A07/MF A01.

The instrumentation and controls (I and C) of an ignited plasma magnetically confined in a tokamak configuration needs increased emphasis in the following areas: (1) physics implications for control; (2) plasma shaping/position control; and (3) control to prevent disruptive instabilities. This document reports on the FY 1979 efforts in these and other areas. Also presented are discusssions in the areas of: (1) diagnostics suitable for the Engineering Test Facility (ETF); and (2) future research and development (R and D) needs. The appendices focus attention on some preliminary ideas about the measurement of the deuteron-triton (D-T) ratio in the plasma, synchrotron radiation, and divertor control. Finally, an appendix documenting the thermal consequences to the first wall of a MPD is presented.

39189 (WFPS-TME—78-100) **Structural evaluation of a DTHR bundle divertor particle collector.** Prevenslik, T.V. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Fusion Power Systems Dept.). Sep 1980. Contract AC02-77ET52043. 36p. NTIS, PC A03/MF A01.

The purpose of this report is to present a structural evaluation of the current bundle divertor particle collector BDPC design under a peak heat flux in relation to criteria that protect against coolant leakage into the plasma over replacement schedules planned during DTHR operation. In addition, an assessment of the BDPC structural integrity at higher heat fluxes is presented. Further, recommendations for modifications in the current BDPC design that would improve design reliability to be considered in future design studies are described. Finally, experimental test programs directed to establishing materials data necessary in providing greater confidence in subsequent structural evaluations of BDPC designs in relation to coolant leakage over planned replacement schedules are identified.

GENERAL AND MISCELLANEOUS

MANAGEMENT

39190 (DOE/AD—0010/11) **Selected DOE Headquarters Publications, October 1979.** (Department of Energy, Washington, DC (USA). Energy Library). Sep 1980. 75p. NTIS, PC A04/MF A01.

This publication provides cumulative listings of and an index to DOE headquarters publications issued since October 1979. (Publications issued during October 1977-September 1979 are covered in DOE/AD-0010/6.) Three types of headquarters publications are included: publications dealing mainly with program and policy that are attributed to and issued by headquarters organizations, reports prepared by contractors (and published by DOE) to describe research and development work they have performed for the Department, and environmental development plans and impact statements. Certain publications have been omitted. They include such items as pamphlets, fact sheets, bulletins, newsletters, and telephone directories, headquarters publications issued under the DOE-tr and CONF codes, technical reports from the Jet Propulsion Laboratory and NASA issued under DOE/JPL and DOE/NASA codes, and weekly/monthly reports of the Energy Information Administration. (RWR)

39191 (DOE/OSE—0003) **Institutional origins of the Department of Energy: the Office of Military Application. Energy History Series Volume 1, No. 1.** Anders, R.M. (Department of Energy, Washington, DC (USA)). Aug 1980. 31p. NTIS, PC A03/MF A01.

The Department of Energy Organization Act of 1977 brought together for the first time in one department most of the government's energy programs. With these programs came a score of organizational entities, each with its own history and traditions, from a dozen departments and independent agencies. This report traces the history of the Office of Military Application, from its inception as the Division of Military Application in the Atomic Energy Commission, through the Energy Research and Development Administration to its present status as an office in the Department of Energy. (RWR)

39192 (DOE/TIC—11270) **Research at the Oak Ridge National Laboratory (ORNL).** Postma, H. (Oak Ridge National Lab., TN (USA)). 1980. Contract W-7405-ENG-26. 31p. NTIS, PC A03/MF A01.

The Oak Ridge National Laboratory is a large (5300 people), US-government-funded laboratory, which performs research in many disciplines and in many technological areas. Programs and organization of ORNL are described for the People's Republic of China. (RWR)

39193 (SAND—80-2211C) **Proofreading: for want of a nail...** Garner, W.L. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 9p. (CONF-801113—1). NTIS, PC A02/MF A01.

From 4. annual practical conference on communications; Gatlinburg, TN, USA (7 Nov 19780).

This report presents only the text of a tape-slide half-hour unit that outlines beginning approaches to proofreading. The presentation was designed primarily for typist-compositors needing first-time or review training. The presentation stresses value and need for accurate proofing, and highlights some basic techniques, special danger areas, copy mark-up, and distinguishing between Greek and Roman alphabets.

MATHEMATICS AND COMPUTERS

REFER ALSO TO CITATION(S) 37763, 38517, 39177

39194 (ANL—80-84) **Improving the accuracy of computed matrix eigenvalues.** Dongarra, J.J. (Argonne National Lab., IL (USA)). Aug 1980. Contract W-31-109-ENG-38. 123p. NTIS, PC A06/MF A01.

A computational method is described for improving the accuracy of a given eigenvalue and its associated eigenvector, arrived at through a computation in a lower precision. The method to be described will increase the accuracy of the pair and do so at a relatively low cost. The technique used is similar to iterative refinement for the solution of a linear system; that is, through the factorization from the low-precision computation, an iterative algorithm is applied to increase the accuracy of the eigenpair. Extended precision arithmetic is used at critical points in the algorithm. The iterative algorithm requires $O(n^2)$ operations for each iteration.

39195 (BNL—28153) **Computer technology forecasting at the National Laboratories.** Peskin, A.M. (Brookhaven National Lab., Upton, NY (USA)). 1980. Contract AC02-76CH00016. 3p. (CONF-801110—1). NTIS, PC A02/MF A01.

From IEEE engineering management conference; Boston, MA, USA (Nov 1980).

The DOE Office of ADP Management organized a group of scientists and computer professionals, mostly from their own national laboratories, to prepare an annually updated technology forecast to accompany the Department's five-year ADP Plan. The activities of the task force were originally reported in an informal presentation made at the ACM Conference in 1978. This presentation represents an update of that report. It also deals with the process of applying the results obtained at a particular computing center, Brookhaven National Laboratory. Computer technology forecasting is a difficult and hazardous endeavor, but it can reap considerable advantage. The forecast performed on an industry-wide basis can be applied to the particular needs of a given installation, and thus give installation managers considerable guidance in planning. A beneficial side effect of this process is that it forces installation managers, who might otherwise tend to preoccupy themselves with immediate problems, to focus on longer term goals and means to their ends. (RWR)

39196 (CONF-801116—1) **Application of microprocessors in measurement.** Johnson, M.R. (EG and G Idaho, Inc., Idaho Falls (USA)). 1980. Contract AC07-76ID01570. 11p. NTIS, PC A02/MF A01.

From International symposium on application of microprocessors in devices for instrumentation and automatic control; London, UK (17 Nov 1980).

IC technology is surveyed, particularly microprocessors, microcomputers, and related devices. With design efforts becoming so software-intensive the question of computer languages and language level is also addressed. To add perspective, the major microprocessor application areas of energy systems, automobiles, and man/machine interfacing are surveyed with emphasis on measurement rather than control. These are representative of the growing usefulness of inexpensive computer intelligence. In addition, two measurement system microprocessor-based design efforts under way at the Idaho National Engineering Laboratory are described. 3 figures.

39197 (COO—2383-0068) **Automatic detection and treatment of oscillatory and/or stiff ordinary differential equations.** Gear, C.W. (Illinois Univ., Urbana (USA). Dept. of Computer Science). Jun 1980. Contract AS02-76ER02383. 25p. (CONF-8004115—1; UIUCDCS-R—80-1019; UILU-ENG—80-1721). NTIS, PC A02/MF A01.

From Differential equation workshop; Bielefeld, F.R. Germany (21 Apr 1980).

The next generation of ODE software can be expected to detect special problems and to adapt to their needs. The low-cost, automatic detection of oscillatory behavior, the determination of its period, and methods for its subsequent efficient integration are addressed here, along with stiffness detection. In the first phase, the method for oscillatory problems discussed examines the output of any integrator to determine if the output is nearly periodic. At the point this answer is positive, the second phase is entered and an automatic, nonstiff, multirevolutionary method is invoked. This requires the occasional solution of a nearly periodic initial-value problem over one period by a standard method and the re-determination of its period. Because the multirevolutionary method uses a very large step, the problem has a high probability of being stiff in this second phase. Hence, it is important to detect if stiffness is present so that an appropriate stiff, multirevolutionary method can be selected. 6 figures.

39198 (COO—2751-4) **Methods in probability and statistical inference. Final report, June 15, 1975-June 30, 1979.** Wallace, D.L.; Perlman, M.D. (Chicago Univ., IL (USA). Dept. of Statistics). Jun 1980. Contract AS02-76ER02751. 38p. NTIS, PC A03/MF A01.

This report describes the research activities of the Department of Statistics, University of Chicago, during the period June 15, 1975 to July 30, 1979. Nine research projects are briefly described on the following subjects: statistical computing and approximation techniques in statistics; numerical computation of first passage distributions; probabilities of large deviations; combining independent tests of significance; small-sample efficiencies of tests and estimates; improved procedures for simultaneous estimation and testing of many correlations; statistical computing and improved regression methods; comparison of several populations; and unbiasedness in multivariate statistics. A description of the statistical consultation activities of the Department that are of interest to DOE, in particular, the scientific interactions between the Department and the scientists at Argonne National Laboratories, is given. A list of publications issued during the term of the contract is included.

39199 (DOE/ER/02310—167) **Robust estimates of location called compromise estimates. Progress report.** Guarino, R. (Princeton Univ., NJ (USA). Dept. of Statistics). Jan 1980. Contract AC02-76ER02310. 52p. NTIS, PC A04/MF A01.

Two types of robust estimates of location, psi-compromised M-estimates and gap-compromised estimates, are discussed and compared via a simulation. The relationships between the two types of estimators are seen to depend on both the sample size and the underlying distribution of the data. 11 figures, 6 tables.

39200 (DOE/EV/10343—8) **RECOG-SIZE: Pattern recognition code RECOG-ORNL.** Begovich, C.L.; Larson, N.M. (Vanderbilt Univ., Nashville, TN (USA). Biomedical Computing Technology Information Center). May 1977. Contract AS05-80EV10343. 122p. NTIS, PC A06/MF A01.

RECOG-ORNL is a general-purpose pattern recognition code that is an ORNL modification of the program RECOG, written and implemented at Lawrence Livermore Laboratory. The code contains various pattern recognition methods for data analysis, preprocessing and display of data, plus unsupervised and supervised learning. The algorithms used and the input data required are described for each available option. A sample run is included. An auxiliary program that calculates the array sizes needed for a data set is also listed. 2 figures, 12 tables.

39201 (LA—8467-MS) **I/O performance measurement on Cray-1 and CDC 7600 computers.** Bucher, I.Y.; Hayes, A.H. (Los Alamos Scientific Lab., NM (USA)). Aug 1980. Contract W-7405-ENG-36. 50p. NTIS, PC A03/MF A01.

Disk I/O transfer rates and overhead CPU times were measured as functions of buffer size and number of logically independent I/O channels for several operating systems on the Cray Research, Inc. (CRI) Cary-1 and on the Control Data Corporation (CDC) 7600. The results for 16 I/O routines are presented and analyzed. On the Cray-1, continuous sequential I/O without missed disk revolutions (except at cylinder boundaries) is possible for the CTSS and COS operating systems. Minimum overhead CPU times are approximately 600 μs for the initiation of the I/O call and 6 μs for the actual transfer of one sector. Effects of memory blocking due to vector operations were observed. On the CDC 7600 under LTSS the most efficient routines miss one disk revolution per I/O call. Minimum overhead CPU times are 1050 μs for the initiation of the call and 42 μs for the transfer of one sector. 14 figures, 31 tables.

39202 (LA-UR—80-2741) **I/O performance measurement on Cray-1 and CDC 7600 computers.** Bucher, I.Y.; Hayes, A.H. (Los Alamos Scientific Lab., NM (USA)). 1980. Contract W-7405-ENG-36. 11p. (CONF-801004—2). NTIS, PC A02/MF A01.

From Computer performance evaluation users group conference; Orlando, FL, USA (Oct 1980).

Disk I/O transfer rates and overhead CPU times were measured as functions of buffer size and number of logically independent I/O channels for several operating systems and 16 I/O routines on the Cray-1 and CDC 7600 computers. By parameterizing the codes for a variable number of channels, buffer sizes, and words transmitted, the effect of these variables is observed for buffered, nonbuffered, and random-access I/O transmissions. To measure CPU-overlapped performance, I/O was performed concurrently with a pretimed compute loop. Rates, sector overhead, and CPU transmission speeds were calculated upon completion of I/O. Effects of memory blocking due to vector operations were observed. Methods and results are presented. 4 figures, 1 table.

39203 (LBL--11290) **Automatic program timing profiles with FTN4.** Friedman, R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1980. Contract W-7405-ENG-48. 24p. (CONF-800981—1). NTIS, PC A02/MF A01.

From VIM-33/ECODU-30 control data user group joint conference; Manchester, UK (22 Sep 1980).

Design of a scheme for producing execution timing profiles of FORTRAN programs automatically is proposed with a recommen-

dation to implement it as an option to the compiler. An experimental implementation on the LBL 7600 is also described. 1 figure.

39204 (LBL—11451) **Managing mass store facilities: Lawrence Berkeley Laboratory's experience with the 7110 Automated Tape Library.** Long, J.M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1980. Contract W-7405-ENG-48. 7p. (CONF-800868—1). NTIS, PC A02/MF A01.

From Managing mass store facilities-AESOP operations managers conference; Chicago, IL, USA (26 Aug 1980).

Lawrence Berkeley Laboratory acquired the Braegen (formerly Cal Comp) 7110 Automated Tape Library as an interim replacement for the IBM 1360 mass storage device. It has a capacity of 2600 slim line tapes and will operate five tape drives. The ATL has had a significant effect on operation, most of which was good. Tape mount time, measured from user request to drive ready, has decreased by a factor of three; recently, the median mount time has been less than one minute. The ATL currently mounts nearly 15,000 reels per month. Tape mount errors have been practically eliminated. The benefits were not derived without expending considerable effort. In addition to the 3-1/2 manyears of systems work, operations spent about one man-year in operator training and documentation. The ATL requires three hours a week for preventive maintenance; remedial maintenance is about double this. Overall, the ATL project has been a success. Error rates have been significantly reduced and users are getting better service. (RWR)

39205 (LLL/LCSD—55) **CRAY-1 user's guide.** Whitten, G.; Hunter, C.; Schroeder, W.; Turin, W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Apr 1980. Contract W-7405-ENG-48. 75p. NTIS, PC A04/MF A01.

This manual describes how to use the CRAY-1 computer from becoming a CRAY-1 user to debugging your CRAY-1 controllee. The general usage-form of the software is described. A detailed description of the software can be found in the referenced documents. Since the CRAY-1 has no input/output peripherals connected, except the terminals, some examples are related to the CDC 7600. This manual should serve as a central document to be complemented by further reading from the documents that are referenced. 5 figures.

39206 (ORNL/CSD—58) **Multi-way stratification problems.** Chernick, M.R.; Wright, T. (Oak Ridge National Lab., TN (USA)). Sep 1980. Contract W-7405-ENG-26. 52p. NTIS, PC A04/MF A01.

An overview is given of some of the previous work in multiway stratification concerning the problem of sample selection when the sample size is less than the total number of strata. Then a technique is introduced for systematically allocating a sample to the strata formed by two-way stratification that proportionately allocates the sample along each of the two variables of stratification. If there are R strata and C strata, respectively, for the first and second variables of stratification, the technique requires that the total sample size be at least as large as max(R,C). An unbiased estimator of the population mean is given, and its variance is obtained. The technique is compared with a random allocation method given by Bryant, Hartley, and Jessen [J. Amer. Statis. Assoc., 55: 105-124]. Numerical examples suggesting when one technique is superior to the other are given. 1 figure, 12 tables.

39207 (ORNL/CSD—59) **FORTRAN subroutine for computing the optimal estimate of f(x).** Gaffney, P.W. (Oak Ridge National Lab., TN (USA)). Oct 1980. Contract W-7405-ENG-26. 71p. NTIS, PC A04/MF A01.

A FORTRAN subroutine called RANGE is presented that is designed to compute the optimal estimate of a function f given values of the function at n distinct points $x_1 < x_2 < \ldots <$ x/sub n/ and given a bound on one of the derivatives of f. We donate this estimate by Ω. It is optimal in the sense that the error abs value (f - Ω) has the smallest possible error bound.

39208 (ORNL/CSD—61) **Mathematics and Statistics Research Department. Progress report, period ending June 30, 1980.** DiZillo-Benoit, P.M.; Lawrence, W.E.; Shepherd, D.E.; Solomon, A.D. (Oak Ridge National Lab., TN (USA)). Sep 1980. Contract W-7405-ENG-26. 80p. NTIS, PC A05/MF A01.

The first part of this report consists of brief summaries of research progress in biometrics research, materials science applications, model evaluation, moving boundary problems, multivariate analysis, numerical linear algebra, risk analysis, and complementary areas. Then the results of collaboration with other researchers on problems in biology and health sciences, chemistry, engineering, energy, environmental sciences, material sciences, safeguards, sampling and surveys, health and safety research, and uranium resource evaluation are recorded. Finally, short accounts of educational activities, lists of written and oral presentations of research results, and a list of other professional activities in which the staff was engaged are given.

39209 (ORNL/CSD/TM—128) **RSTS/E communications link via an asynchronous multiplexer.** Million, D.L. (Oak Ridge National Lab., TN (USA)). Sep 1980. Contract W-7405-ENG-26. 47p. NTIS, PC A03/MF A01.

The Biology Division of Oak Ridge National Laboratory had an immediate need for a communications link between two PDP-11 computers, to allow timesharing users to transfer disk files between systems, while waiting for software development on a more general communications system. A program was written to use one line of a DZ11 asynchronous multiplexer on each computer for communications, and thus make a simple hardware connection with a RS232C null modem possible. A second program was written to permit easy user access to the link. Development, implementation, and performance of the programs are described.

39210 (PNL-SA—8781) **ALDS 1979 panel review.** Hall, D.L. (ed.). (Battelle Pacific Northwest Labs., Richland, WA (USA)). Aug 1980. Contract AC06-76RL01830. 113p. NTIS, PC A06/MF A01.

The overall goal of PNL Applied Mathematical Sciences Research is development of a DOE capability for Analysis of Large Data Sets (ALDS) and transfer of this capability to other DOE laboratories and contractors. This capability is needed to satisfy DOE's increasing requirements for handling and analyzing large volumes of diverse energy and environmental data. The integrated statistics and computer science research include the development of improved methodologies in data definition, data management, data analysis, and visual display. The research is centered around a continuously evolving PNL statistical laboratory dedicated, first, to the analysis of large data sets of importance to DOE, and second, to providing an environment for development and demonstration of new data handling, analysis, and display methods. A peer review panel of expert statisticians and computer scientists from DOE laboratories, universities, government agencies, and the private sector meets annually to guide, evaluate, and critique the research and to help disseminate progress to the scientific community. The panel met on November 8 and 9, 1979, at PNL in Richland, Washington. The first day PNL staff briefed the panel on the progress made in computer science and statistics during FY79 and discussed the future directions of the ALDS project. During the morning of November 9, each panel member was asked to describe his overall impression of the project, comment specifically on the previous year's progress, and offer guidance for the direction of research and implementation. The afternoon was spent in small discussion groups on specific topics with members of the panel. (RWR)

39211 (SAND—79-2444) **Type-insensitive ODE codes based on implicit a-stable formulas.** Shampine, L.F. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1980. Contract AC04-76DP00789. 29p. NTIS, PC A03/MF A01.

A special concept of stiffness is appropriate for implicit A-stable formulas. It is possible to recognize this kind of stiffness economically and reliably by use of information readily available during the integration of an ODE. Using this development, a variety of effective ODE solvers could be made insensitive to the type of problem, i.e. the code would automatically recognize and alter automatically its algorithm at any step depending on whether the problem is stiff there.

39212 (SAND—80-0710C) **Serial nonvolatile 1024 bit MNOS memory.** Dodson, W.H.; Sokel, R.J. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 3p. (CONF-801108—1). NTIS, PC A02/MF A01.

From Government microcircuit applications conference; Houston, TX, USA (19 Nov 1980).

The characteristics and operation of a nonvolatile MNOS sequential memory designed and built by Sandia National Laboratories for DOD are described. First, a general description and block diagram are presented, followed by the power, voltage, clock and address requirements, and then operating descriptions for the control and data signals. 1 figure, 1 table.

39213 (SAND—80-0821) **Overview of a minicomputer network.** Vahle, M.O.; Tolendino, L.F. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1980. Contract AC04-76DP00789. 29p. NTIS, PC A03/MF A01.

A computer network was developed to support minicomputers used at a number of locations within Sandia National Laboratories. This report describes the control strategies, capabilities, and design philosophies of the minicomputer network. 2 figures.

39214 (SAND—80-1260) **Weighted linear least squares problem: an interval analysis approach to rank determination.** Manteuffel, T.A. (Sandia National Labs., Albuquerque, NM (USA)). Aug 1980. Contract AC04-76DP00789. 25p. NTIS, PC A02/MF A01.

This is an extension of the work in SAND—80-0655 to the weighted linear least squares problem. Given the weighted linear least squares problem WAx ≃ Wb, where W is a diagonal weighting matrix, and bounds on the uncertainty in the elements of A, we

define an interval matrix A/sup I/ that contains all perturbations of A due to these uncertainties and say that the problem is rank deficient if any member of A/sup I/ is rank deficient. It is shown that, if WA = QR is the QR decomposition of WA, then Q and R^{-1} can be used to bound the rank of A/sup I/. A modification of the Modified Gram—Schmidt QR decomposition yields an algorithm that implements these results. The extra arithmetic is 0(MN). Numerical results show the algorithm to be effective on problems in which the weights vary greatly in magnitude.

39215 (SAND—80-1303C) **High performance multiplier processor for use with aerospace microcomputers.** Pierce, P.E. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 12p. (CONF-801117—1). NTIS, PC A02/MF A01.

From NASA/AIAA workshop on aerospace applications of microprocessors; Greenbelt, MD, USA (3 Nov 1980).

An MC 68000-based microcomputer including a hardware multiplier processor has been designed for a re-entry vehicle navigation and control application. The microcomputer is discussed with emphasis on the multiplier processor architecture, software control, and theory of operation. 2 figures.

39216 (SAND—80-1861C) **Latin hypercube sampling for the simulation of certain nonmonotonic response functions.** Diegert, K.V.; Diegert, C. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 14p. (CONF-800820—8). NTIS, PC A02/MF A01.

From American Statistical Society meeting; Houston, TX, USA (11 Aug 1980).

The Latin Hypercube Sampling, LHS, plan was presented by McKay, Beckman and Conover [Technometrics, 21, 239 - 245(May 1979)] as an alternative to simple random sampling, SRS, in Monte Carlo studies. For each realization of random input vector X, suppose that a computer code produces a scalar output Y = h(X). The referenced paper proves that, when h is monotonic in each of its arguments, some common summary statistics on Y are more efficient under LHS than under SRS. This monotonicity restriction on h excludes some interesting response functions. For example, suppose X is a vector of a mission's sensor measurements, and Y = h(X) is one when the mission is successful and zero otherwise. Function h is not monotonic in a common case; it is not monotonic if success occurs when X is near the true value, and failure occurs when X departs sufficiently from this value in any direction. Conditions on h, general enough to include this setting, are given under which LHS produces more efficient estimates than SRS.

39217 (SAND—80-1951C) **Generations of orthogonal surface coordinates.** Blottner, F.G.; Moreno, J.B. (Sandia National Labs., Albuquerque, NM (USA)). 1980. Contract AC04-76DP00789. 14p. (CONF-801058—1). NTIS, PC A02/MF A01.

From Workshop on grid generation; Hampton, VA, USA (6 Oct 1980).

An orthogonal surface-oriented coordinate system has been developed for three-dimensional flows where the computational domain normal to the surface is small. With this restriction the coordinate system requires orthogonality only at the body surface. This coordinate system has been utilized in boundary layer flows and for the hypersonic viscous shock-layer problem. Two methods have been developed for generating the surface coordinates. 9 figures. (RWR)

39218 (SAND—80-2080C) **Digital simulation and modeling of nonlinear stochastic systems.** Richardson, J.M.; Rowland, J.R. (Sandia National Labs., Albuquerque, NM (USA); Oklahoma State Univ., Stillwater (USA). School of Electrical Engineering). 1980. Contract AC04-76DP00789. 16p. (CONF-801049—2). NTIS, PC A02/MF A01.

From 1980 international conference of cybernetics and systems; Cambridge, MA, USA (8 Oct 1980).

Digitally generated solutions of nonlinear stochastic systems are not unique, but depend critically on the numerical integration algorithm used. Some theoretical and practical implications of this dependence are examined. The Ito-Stratonovich controversy concerning the solution of nonlinear stochastic systems is shown to be more than a theoretical debate on maintaining Markov properties as opposed to utilizing the computational rules of ordinary calculus. The theoretical arguments give rise to practical considerations in the formation and solution of discrete models from continuous stochastic systems. Well-known numerical integration algorithms are shown not only to provide different solutions for the same stochastic system, but also to correspond to different stochastic integral definitions. These correspondences are proved by considering first and second moments of solutions resulting from different integration algorithms and comparing the moments to those arising from various stochastic integral definitions. Monte Carlo simulations and statistical tests are applied to illustrate the determining role that computational procedures play in generating solutions. This algorithm dependence of solutions is in sharp contrast to the deterministic and linear stochastic cases, in which unique solutions are determined by any convergent numerical algorithm. Consequences of this relationship between stochastic system solutions and simulation procedures are presented for a nonlinear filtering example. 2 figures.

39219 (UCID—18799) **User's manual. SPIN, a program for 3-D axisymmetric geometry generation.** Brown, B.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Aug 1980. Contract W-7405-ENG-48. 35p. NTIS, PC A03/MF A01.

SPIN is designed to take two-dimensional quadrilateral input, rotate the data about an axis, and produce three-dimensional bricks. The two-dimensional database is discussed in this manual (it is the same as the output of the ZONE program [UCID-17139]). The output of SPIN is in the format for the DYNA3D/NIKE3D programs [UCID-17268]. Both the input and output files are card images, not binary, so the files may be easily edited with a text editor for any other program. Additionally, the slide-planes between various layers may also be generated. The program is available on both CDC7600 and CRAY-1 computers.

39220 (UCRL—50025-80-1, pp 21-25) **General purpose interface bus effective for networking microcomputers.** 1 Apr 1980.

In Electronics Engineering Department. Quarterly report No. 1, 1980.

As the proliferation of microcomputers continues, it is more and more necessary to network these microcomputers. Because these microcomputers have small memory size and limited speed, they do not adapt well to the network approach used on larger computers. Microcomputers cannot support the software and hardware overhead usually found in large computers. An effective way for handling the networking is needed, and the general-purpose interface bus is one answer. 4 figures.

39221 (UCRL—52995) **Verification of timing constraints on large digital systems.** McWilliams, T.M. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). May 1980. Contract W-7405-ENG-48. 112p. NTIS, PC A06/MF A01.

A new approach to the verification of timing constraints on large digital systems has been developed. The associated algorithm is computationally efficient, and provides early and continuous feedback about the timing aspects of synchronous sequential circuits as they are designed. It also provides means for conveniently verifying the design section-by-section for designs that are too large to examine as a unit. This approach is new in that it uses a stable value to represent signals in the large majority of instances in which it is unnecessary to know whether the signals are true or false in order to examine satisfaction of the timing constraints. For the remaining instances, it represents the full value behavior of signals. This use of the stable value greatly reduces the number of states through which a digital system needs to be taken in the process of verifying its timing constraints. Not needing to know the values of most signals also greatly reduces the size of the data base needed to drive the verification process. Both of these savings are of exponential order. This approach thus makes feasible for the first time the exhaustive examination of complex digital circuits for satisfaction of timing constraints. A system has been implemented which takes a digital logic design specified in the SCALD Hardware Description Language, and verifies all of the timing constraints specified within it. This system has been used in the design of a very high-performance central processing unit, the S-1 Mark IIA processor. The use of the Timing Verifier allowed timing errors to be identified early in the design process. Such timely error elimination has permitted the design to be completed more rapidly, and has also supported the creation of a design which will perform more rapidly without timing errors, when it is implemented in hardware. 28 figures, 3 tables.

39222 (UCRL—84090) **Wargaming and interactive color graphics.** Bly, S.; Buzzell, C.; Smith, G. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). 4 Aug 1980. Contract W-7405-ENG-48. 7p. (CONF-800819—3). NTIS, PC A02/MF A01.

From Summer computer simulation conference; Seattle, WA, USA (25 Aug 1980).

JANUS is a two-sided interactive color graphic simulation in which human commanders can direct their forces, each trying to accomplish their mission. This competitive synthetic battlefield is used to explore the range of human ingenuity under conditions of incomplete information about enemy strength and deployment. Each player can react to new situations by planning new unit movements, using conventional and nuclear weapons, or modifying unit objectives. Conventional direct fire among tanks, infantry fighting vehicles, helicopters, and other units is automated subject to constraints of target acquisition, reload rate, range, suppression, etc. Artillery and missile indirect fire systems deliver conventional munitions, smoke, and nuclear weapons. Players use reconnaissance units, helicopters, or fixed wing aircraft to search for enemy unit locations. Counter-battery radars acquire enemy artillery. The JANUS simulation at LLL has demonstrated the value of the computer as a sophisticated blackboard. A small dedicated minicomputer is adequate for detailed calculations, and may be preferable to sharing a more powerful machine. Real-time color interactive graphics are

essential to allow realistic command decision inputs. Competitive human-versus-human synthetic experiences are intense and well-remembered. 2 figures.

39223 (UCRL—84319(Rev.1)) **Resource access control in a network operating system.** Donnelley, J.E.; Fletcher, J.G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Aug 1980. Contract W-7405-ENG-48. 13p. (CONF-801112—1(Rev.1)). NTIS, PC A02/MF A01.

From ACM Pacific 80 conference; San Francisco, CA, USA (12 Nov 1980).

Computer systems being incorporated into mature support networks are facing a substantial protocol-implementation effort in granting controlled access to their resources and in obtaining access to network-supplied resources. This protocol-implementation effort can be significantly reduced by use of resource-sharing protocols that are independent of specific resource semantics. A capability-passing model for distributed access control is described and several capability-management protocols are discussed. Highlights of the discussion include the inalienable right to pass capabilities, capability theft through data theft and reflection, capability management by public key encryption, a capability passing structure, and resource sharing with integrated network directories. 9 figures, 2 tables.

39224 (UCRL—84549) **User services in a network environment.** O'Dell, J.M.; Scott, A.B. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). Jun 1980. Contract W-7405-ENG-48. 8p. (CONF-801105—1). NTIS, PC A02/MF A01.

From 8. annual user services conference; Morgontown, WV, USA (16 Nov 1980).

User services in a network environment are quite different from those in environments with users in close proximity. Communication with remote users with advanced degrees requires different attitudes, knowledge, and techniques. The problems and solutions of education, documentation, software tools, and helping users debug programs over long distances are presented. 1 figure.

39225 **Power studies of tests for uniformity. II.** Miller, F.L. Jr. (Union Carbide Corp., Oak Ridge, TN); Quesenberry, C.P. *Commun. Stat. Pt. B: Simul. Comput.;* **8**: No. 3, 271-290(1979).

Results from a power study of six statistics for testing that a sample is from a uniform distribution on the unit interval (0,1) are reported. The test statistics are all well-known, and each of them was originally proposed because it should have high power against some alternative distributions. The tests considered are the Pearson probability product test, the Neyman smooth test, the Sukhatme test, the Durbin-Kolmogorov test, the Kuiper test, and the Sherman test. Results are given for each of these tests against each of four classes of alternatives. Also, the most powerful test against each member of the first three alternatives is obtained, and the powers of these tests are given for the same sample sizes as for the six general omnibus test statistics. These values constitute a power envelope against which all tests can be compared. The Neyman smooth tests with 2nd and 4th degree polynomials are found to have good power and are recommended as general tests for uniformity. 4 figures, 5 tables.

39226 **Further approximate Pearson percentage points and Cornish-Fisher.** Bowman, K.O. (Union Carbide Corp., Oak Ridge, TN); Shenton, L.R. *Commun. Stat. Pt. B: Simul. Comput.;* **8**: No. 3, 231-244(1979).

A set of 19-point rational fraction approximants for Pearson distributions at levels $\alpha = 0.025, 0.25, 0.50, 0.75$, and 0.975 is added to a previous study [Biometrika; 66: No. 1 (1979)]. The relation to a Cornish-Fisher expansion is discussed, and advice, proffered on interpolation for a new deviate or new level. 1 figure, 3 tables.

39227 **Some limitations of dimensional analysis and power laws.** Hicks, B.B. (Argonne National Lab., IL). *Boundary-Layer Meteorol.;* **14**: 567-569(1978).

An artificial correlation introduced as a direct consequence of constructing dimensionless quantities from sets of unrelated data is investigated. The analysis results in expressions for the induced correlation coefficient and power-law exponent that permit workers to examine the objectivity of results obtained with this method of data analysis.

39228 **How many 3-term arithmetic progressions can there be if there are no longer ones.** Simmons, G.J.; Abbott, H.L. *Am. Math. Mon.;* **84**: No. 8, 633-635(Oct 1977).

Let script-A/sub k/(n) be the set of n-term nonnegative integer sequences that contain no k-term arithmetic progression (AP) as a subsequence. Denote by f(A) the number of 3-term APs in the sequence A. Define f/sub k/(n) = max f(A) for A an element of script-A/sub k/(n) and s/sub k/ = lim/sub n→∞/ log f/sub k/(n)/ log n. It is shown that $f_4(n) \geq n^{1.623}$ infinitely often and that s/sub k/ → 2 as k → ∞. The question of determining lim/sub n→∞/ $f_4(n)$ and, more generally, of determining s/sub k/ is addressed. (RWR)

INFORMATION HANDLING

REFER ALSO TO CITATION(S) 37623, 38231, 38846, 39206

39229 (DOE/TIC—4579(Rev.11)) **Energy Information Data Base: serial titles.** (Department of Energy, Oak Ridge, TN (USA). Technical Information Center). Jun 1980. 665p. NTIS, PC A99/MF A01.

The Department of Energy Technical Information Center (TIC) is responsible for creating bibliographic data bases that are used in the announcement and retrieval of publications dealing with all phases of energy. The TIC interactive information processing system makes use of a number of computerized authorities so that consistency can be maintained and indexes can be produced. One such authority is the Energy Information Data Base: Serial Titles. This authority contains the full and abbreviated journal title, country of publication, CODEN, and certain codes. This revision replaces previous revisions of this document. (RWR)

39230 (DOE/TIC—4585(Rev.2)) **Energy Information Data Base: corporate author entries.** (Department of Energy, Oak Ridge, TN (USA). Technical Information Center). Jun 1980. 612p. NTIS, PC A99/MF A01.

One of the controls for information entered into the data bases created and maintained by the DOE Technical Information Center is the standardized name for the corporate entity or the corporate author. The purpose of Energy Information Data Base: Corporate Author Entries is to provide a means for the consistent citing of the names of organizations in bibliographic records. These entries serve as guides for users of the DOE/RECON computerized data bases who want to locate information originating in particular organizations. The entries in this revision include the corporate entries used in report bibliographic citations since 1973 and list approximately 28,000 corporate sources. (RWR)

39231 (ORNL/TM—7156) **Refinements to the Boolean approach to automatic data editing.** Liepins, G.E. (Oak Ridge National Lab., TN (USA)). Sep 1980. Contract W-7405-ENG-26. 42p. NTIS, PC A03/MF A01.

Automatic data editing consists of three components: identification of erroneous records, identification of most likely erroneous fields within an erroneous record (fields to impute), and assignment of acceptable values to failing records. Moreover the types of data considered naturally fall into three categories: coded (categorical) data, continuous data, and mixed data (both coded and continuous). For the case of coded data, a natural way to approach automatic data is commonly referred to as the Boolean approach, first developed by Fellegi and Holt. For the fields to impute problem, central to the operation of the Fellegi-Holt approach is the explicit recognition of certain implied edits; Fellegi and Holt orginally required a complete set of edits, and their algorithm to generate this complete set has occasionally had the distinct disadvantage of failing to converge within reasonable time. The primary results of this paper is an algorithm that significantly prunes the Fellegi-Holt edit generation process, yet, nonetheless, generates a sufficient collection of implied edits adequate for the solution of the fields to impute problem. 3 figures.

CORPORATE INDEX

In the Corporate Index, report literature is indexed using the name of the organization or institution responsible for issuing the report. Headings are provided for all report literature and for published literature for which a corporate approach is especially desirable, e.g., symposium and conference proceedings.

Each entry under a corporate heading gives the report title and the volume and abstract numbers. Report numbers, if applicable, are given in parentheses at the end of the entry.

DOE Energy Information Data Base: Corporate Author Entries (TID-4585) is used in the standardization of corporate entries. TID-4585 is available for purchase from the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, Virginia 22161.

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Production of methane using offshore wind energy. Quarterly progress report, 1 Apr-30 Jun 1975, 5:38049 (PB—80-129158)

Acurex Corp., Mountain View, CA (USA). Energy and Environmental Div.
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Quantification of municipal disposal methods for industrially generated hazardous wastes. Final report, 1978-1979, 5:38301 (PB—80-140528)

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Evaluation of fission product yields for the US national nuclear data files, 5:39077 (HEDL-SA—2205)
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FGD sludge disposal manual. Final report, 5:38087 (EPRI-CS—1515)
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The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processses applied to, the subject term.

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5	5:38313	NTIS, PC A04/MF A01
CONF-7910104-		(4. United States gulf coast geopressured-geothermal energy conference, Austin, TX, USA, 29-31 Oct 1979)
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	5:38570	*See* LBL-10301
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CONF-7910144-	(42. annual meeting of the American Society for Information Science, Minneapolis, MN, USA, 14-18 Oct 1979)	
	5:38231	White Plains, NY; Knowledge Industry Publications, Inc. (1979).
	5:39106	16: 276-285(1979)
CONF-7911112-	(Symposium on the implications of our failure to detect extraterrestrials in the solar system, College Park, MD, USA, Nov 1979)	
1	5:38904	*See* LA-UR-80-2551
CONF-800208-	(Topical meeting on inertial confinement fusion, San Diego, CA, USA, 26-28 Feb 1980)	
19	5:38536	*See* KMSF-U-944
21	5:39167	NTIS, PC A02/MF A01
CONF-800252-	(18. winter school on physics, selected topics in nuclear structure, Bielsko-Biala, Poland, 11-12 Feb 1980)	
1	5:39012	NTIS, PC A04/MF A01
CONF-800374-	(15. Rencontre de Moriond, Les Arcs, France, 9-21 Mar 1980)	
8	5:38948	*See* DOE/ER/02232-87
CONF-8003103-	(Workshop on water supply for electric energy, Palo Alto, CA, USA, 19-21 Mar 1980)	
	5:38250	*See* EPRI-WS-79-237
CONF-8003106-	(Symposium on the biological risks of medical irradiations, San Antonio, TX, USA, 26-28 Mar 1980)	
1	5:38832	NTIS, PC A02/MF A01
CONF-8003107-	(International dome symposium, Winooski, VT, USA, 27 Mar 1980)	
1	5:38305	NTIS, PC A02/MF A01
CONF-800426-	(6. international conference on solid state dosimetry, Toulouse, France, 1-4 Apr 1980)	
3	5:38625	NTIS, PC A02/MF A01
CONF-800427-	(Tritium technology in fission, fusion, and isotopic applications, Dayton, OH, USA, 29 Apr-1 May 1980)	
19(Draft)	5:39158	NTIS, PC A02/MF A01
CONF-800428-	(6. international conference on fluidized bed combustion, Atlanta, GA, USA, 9-11 Apr 1980)	
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CONF-800431-	(Nuclear criticality safety topical meeting, El Paso, TX, USA, 8-10 Apr 1980)	
6	5:38530	NTIS, PC A02/MF A01
CONF-800455-	(4. international conference on plasma surface interactions in controlled fusion devices, Garmisch, F.R. Germany, 21-25 Apr 1980)	
20(Draft)	5:39159	NTIS, PC A03/MF A01
21	5:39181	NTIS, PC A02/MF A01
CONF-800491-	(Solar power satellite program review, Lincoln, NB, USA, 22-25 Apr 1980)	
	5:37815	NTIS, PC A99/MF A01
	5:37857	NTIS, PC A99/MF A01
	5:37858	NTIS, PC A99/MF A01
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CONF-800498-	(Symposium on mutagenesis and carcinogenesis, Warsaw, Poland, 21-24 Apr 1980)	
2	5:38847	NTIS, PC A02/MF A01
3	5:38848	NTIS, PC A02/MF A01
CONF-8004102-	(6. international conference on experimental meson spectroscopy, Upton, NY, USA, 25-26 Apr 1980)	
3	5:38949	*See* SLAC-PUB-2530
4	5:38955	*See* SLAC-PUB-2542
CONF-8004103-	(DOE advanced gas turbine central power systems workshop, Washington, DC, USA, 30 Apr-2 May 1980)	
	5:38064	NTIS, PC A09/MF A01
CONF-8004109-	(3. international guayule conference, Pasadena, CA, USA, 29 Apr-1 May 1980)	
(Exc.)	5:37846	Washington, DC; National Science Foundation (1980).
CONF-8004115-	(Differential equation workshop, Bielefeld, F.R. Germany, 21 Apr 1980)	
1	5:39197	*See* COO-2383-0068
CONF-800542-	(Concrete decontamination workshop, Seattle, WA, USA, 28-29 May 1980)	
5(Draft)	5:38531	NTIS, PC A02/MF A01
CONF-800578-	(Conference on the utilization of small and medium size power reactors in Latin America, Montevideo, Uruguay, 12-15 May 1980)	
2	5:38127	*See* GA-A-15863
CONF-800588-	(International symposium on high energy e+e- interactions, Nashville, TN, USA, 1-3 May 1980)	
2	5:38954	*See* SLAC-PUB-2538
CONF-800602-	(Symposium on instrumentation and control for fossil energy processes, Virginia Beach, VA, USA, 9-11 Jun 1980)	
9(Draft)	5:37504	NTIS, PC A02/MF A01
CONF-800607-	(American Nuclear Society annual meeting, Las Vegas, NV, USA, 8-13 Jun 1980)	
87(Draft)	5:38181	NTIS, PC A02/MF A01
CONF-800608-	(Air Pollution Control Association annual meeting, Montreal, Canada, Jun 1980)	
4	5:37511	NTIS, PC A02/MF A01
CONF-800610-	(American Institute of Chemical Engineering conference, Philadelphia, PA, USA, 8-12 Jun 1980)	
10(Draft)	5:37494	NTIS, PC A02/MF A01
CONF-800626-	(6. international conference on vacuum ultraviolet radiation physics, Charlottesville, VA, USA, 2-6 Jun 1980)	
1	5:38802	*See* BNL-27621
CONF-800648-	(GCFRP program technical review meeting, San Diego, CA, USA, 4-6 Jun 1980)	
16	5:38135	*See* GA-A-15894
CONF-800661-	(7. international conference on numerical methods in fluid dynamics, Palo Alto, CA, USA, 23-27 Jun 1980)	
3	5:38545	*See* UCRL-83673
CONF-800684-	(International conference on experimentation at LEP, Uppsala, Sweden, 16-20 Jun 1980)	
8	5:38620	*See* BNL-28328
CONF-8006119-	(Nobel symposium 50 nuclei at very high spin-sven gosta nilsson in memoriam, Orenas, Sweden, 23-27 Jun 1980)	
1	5:39051	*See* BNL-28226

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CONF-8006123-		(5. tandem conference, Catania, Italy, 9-12 Jun 1980)
1	5:38607	NTIS, PC A02/MF A01
CONF-8006127-		(International conference on interacting bose-fermi systems in nuclei, Erice, Sicily, Italy, 12-19 Jun 1980)
1	5:39083	*See* BNL-28357
CONF-800707-		(8. international conference on plasma physics and controlled nuclear fusion research, Brussels, Belgium, 1-10 Jul 1980)
22(Draft)	5:39136	*See* IAEA-CN-38/A-5
CONF-800724-		(20. international conference on high energy physics, Madison, WI, USA, 17-23 Jul 1980)
24	5:38977	*See* FERMILAB-CONF-80/74-THY
25	5:39005	*See* FERMILAB-CONF-80/71-THY
28	5:39007	*See* SLAC-PUB-2540
29	5:38950	*See* SLAC-PUB-2599
31	5:38998	*See* SLAC-PUB-2574
33	5:38983	*See* SLAC-PUB-2596
CONF-800739-		(6. international fermentation symposium and 5. international symposium on yeasts, London, Ontario, Canada, 20-25 Jul 1980)
2(Draft)	5:38806	NTIS, PC A02/MF A01
CONF-800740-		(11. international conference on high energy accelerators, Geneva, Switzerland, 7-11 Jul 1980)
15	5:38617	*See* SLAC-PUB-2552
16	5:38619	*See* SLAC-PUB-2555
17	5:38597	*See* SLAC-PUB-2560
18	5:38598	*See* SLAC-PUB-2561
19	5:38612	*See* SLAC-PUB-2559
21	5:38618	*See* SLAC-PUB-2553
22	5:38596	*See* SLAC-PUB-2543
CONF-800743-		(International conference on nuclear waste transmutation, Austin, TX, USA, 22-24 Jul 1980)
10	5:37724	*See* UCRL-84405
12	5:37712	NTIS, PC A02/MF A01
13	5:37711	*See* BNL-28193
CONF-800747-		(Review group conference on advanced instrumentation for reactor safety research, Oak Ridge, TN, USA, 29-31 Jul 1980)
1	5:37775	*See* SAND-80-1571C
CONF-800750-		(Meeting for DOE enhanced oil recovery project, San Francisco, CA, USA, 22-24 Jul 1980)
	5:37599	NTIS, PC A20/MF A01
	5:37600	NTIS, PC A20/MF A01
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	5:37603	NTIS, PC A20/MF A01
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	5:38889	NTIS, PC A20/MF A01
CONF-800763-		(Baryon 80 conference, Toronto, Canada, 14-16 Jul 1980)
2	5:38969	*See* LBL-11150
CONF-800766-		(5. international conference on hyperfine interactions, Berlin, F.R. Germany, 21-25 Jul 1980)
2	5:39067	NTIS, PC A02/MF A01
CONF-800769-		(Southwestern fertilizer conference, Houston, TX, USA, 17 Jul 1980)
1	5:38291	NTIS, PC A02/MF A01
CONF-800802-		(89. annual meeting of the American Institute of Chemical Engineers, Portland, OR, USA, 17-20 Aug 1980)
17	5:37797	*See* PNL-SA-8049
19(Draft)	5:37694	NTIS, PC A02/MF A01
20	5:38474	*See* SAND-80-0960C
CONF-800804-		(ASME century 2 emerging technology conference, San Francisco, CA, USA, 10-22 Aug 1980)
27	5:38136	*See* HEDL-SA-1933
28	5:38174	*See* HEDL-SA-1994-FP
29	5:38137	*See* HEDL-SA-1955
30	5:38173	*See* HEDL-SA-1991-FP
31	5:38138	*See* HEDL-SA-1992-FP
CONF-800814-		(180. American Chemical Society meeting/2. chemical congress of the North American Continent, San Francisco, CA, USA, 24-29 Aug 1980)
17	5:37700	*See* DPSPU-80-30-6
19(Draft)	5:38504	NTIS, PC A03/MF A01
22(Draft)	5:38177	NTIS, PC A03/MF A01
CONF-800819-		(Summer computer simulation conference, Seattle, WA, USA, 25-27 Aug 1980)
3	5:39222	*See* UCRL-84090
CONF-800820-		(American Statistical Society meeting, Houston, TX, USA, 11-14 Aug 1980)
8	5:39216	*See* SAND-80-1861C
12	5:38216	NTIS, PC A03/MF A01
CONF-800824-		(5. international symposium on polarization phenomena in nuclear physics, Santa Fe, NM, USA, 11-15 Aug 1980)
22	5:39015	*See* LA-UR-80-2721
CONF-800829-		(International conference on the few body problems, Eugene, OR, USA, 17-23 Aug 1980)
8	5:39082	*See* SLAC-PUB-2595
CONF-800863-		(International conference on nuclear physics, Berkeley, CA, USA, 24-30 Aug 1980)
1	5:39044	NTIS, PC A02/MF A01
CONF-800868-		(Managing mass store facilities-AESOP operations managers conference, Chicago, IL, USA, 26-28 Aug 1980)
1	5:39204	*See* LBL-11451
CONF-800869-		(Quadrennial international ozone symposium, Boulder, CO, USA, 4-9 Aug 1980)
2	5:38696	*See* UCRL-84069
CONF-800870-		(10. international conference on electromagnetic isotope separators, Zinal, Switzerland, 31 Aug-6 Sep 1980)
1	5:37774	NTIS, PC A02/MF A01
CONF-800871-		(International symposium on solar energy utilization, London, Ontario, Canada, 10-24 Aug 1980)
1	5:37903	*See* MLM-2770(OP)
CONF-800872-		(International astronomical union colloquium 58 on stellar hydrodynamics, Los Alamos, NM, USA, Aug 1980)
3	5:38901	*See* LA-UR-80-2725
4	5:38902	*See* LA-UR-80-2756
5	5:38905	*See* LA-UR-80-2787
CONF-800874-		(Varenna workshop on physics of plasmas close to thermonuclear conditions, Varenna, Italy, 27 Aug-7 Sep 1980)
1(Draft)	5:39162	*See* ORNL/TM-7124(Draft)
CONF-800927-		(7. annual national energy division conference, Houston, TX, USA, 29-31 Sep 1980)
2	5:37884	*See* SERI/TP-641-773
CONF-800928-		(8. international vacuum congress/ 4. international conference on surface science and 3. European conference on solid surface, Cannes, France, 22-26 Sep 1980)
4	5:38353	NTIS, PC A02/MF A01
CONF-800942-		(ANS topical meeting on 1980 advances in reactor physics and shielding, Sun Valley, ID, USA, 14-17 Sep 1980)
4	5:38144	NTIS, PC A02/MF A01
7	5:38172	*See* GEFR-SP-00445
8	5:39069	NTIS, PC A02/MF A01
9	5:38182	NTIS, PC A02/MF A01
10	5:38114	NTIS, PC A02/MF A01
11	5:39070	*See* LA-UR-80-2675
12	5:38131	*See* BNL-28288
14	5:38183	NTIS, PC A02/MF A01
16	5:38626	*See* HEDL-SA-2111-5
CONF-800943-		(National topical meeting of fuel cycles for the 80's, Gatlinburg, TN, USA, 29 Sep-2 Oct 1980)
12	5:37697	*See* DP-MS-80-10

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13	5:37698	*See* DP-MS-80-12
14	5:37695	NTIS, PC A02/MF A01
15	5:37696	NTIS, PC A03/MF A01
CONF-800946-	(IAEA specialists meeting on gas cooled reactor safety and licensing aspects, Lausanne, Switzerland, 1-5 Sep 1980)	
1	5:38193	*See* GA-A-15994
CONF-800958-	(Conference of themal infrared sensing applied to energy conservation in building envelopes (thermo sense III), Minneapolis, MN, USA, 2-5 Sep 1980)	
1(Rev.)	5:37908	*See* SERI/TP-351-540(Rev.)
CONF-800962-	(Electrical overstress/electrostatis discharge symposium, San Diego, CA, USA, 9 Sep 1980)	
1	5:38550	*See* SAND-80-0957C
CONF-800963-	(5. international photosynthesis congress, Kassandra-Halkidiki, Greece, 7-13 Sep 1980)	
3	5:37785	*See* BNL-28334
CONF-800967-	(6. GCFR heat transfer specialist meeting, Berkeley, UK, 18-19 Sep 1980)	
1	5:38132	NTIS, PC A02/MF A01
CONF-800970-	(29. annual conference of the Standards Engineering Society, Minneapolis, MN, USA, 23 Sep 1980)	
1	5:38145	NTIS, PC A02/MF A01
CONF-800971-	(CNSI specialist meeting on safety aspects of fuel behavior in off-normal and accident conditions, Helsinki, Finland, 1-4 Sep 1980)	
1	5:38184	NTIS, PC A04/MF A01
2	5:38185	NTIS, PC A03/MF A01
CONF-800972-	(1980 Department of Energy passive and hybird solar energy program update meeting, Washington, DC, USA, 21-24 Sep 1980)	
3	5:37888	*See* LA-UR-80-2633
CONF-800973-	(11. biomass thermochemical conversion contractors meeting, Richland, WA, USA, 23-24 Sep 1980)	
1	5:37791	NTIS, PC A02/MF A01
CONF-800974-	(International symposium on radioiodines, Banff, Alberta, Canada, 13-16 Sep 1980)	
1	5:38503	*See* BNL-28275
CONF-800978-	(5. international symposium on contamination control of ICCCS, Munich, F.R. Germany, 15-17 Sep 1980)	
1	5:38521	*See* UCRL-84237
CONF-800979-	(Workshop on nuclear data evaluation methods and procedures, Upton, NY, USA, 22-25 Sep 1980)	
1	5:39030	NTIS, PC A02/MF A01
3	5:39045	*See* LA-UR-80-2674
4	5:39087	*See* LA-UR-80-2673
7	5:39009	*See* LA-UR-80-2684
CONF-800980-	(Applied superconductivity conference, Santa Fe, NM, USA, 29 Sep-2 Oct 1980)	
5	5:38201	*See* LA-UR-80-2589
6	5:39154	*See* LA-UR-80-2742
8	5:39146	NTIS, PC A02/MF A01
11	5:38526	NTIS, PC A02/MF A01
12	5:38527	NTIS, PC A02/MF A01
13	5:39150	*See* GA-A-16012
14	5:39152	*See* GA-A-16014
15	5:39151	*See* GA-A-16013
CONF-800981-	(VIM-33/ECODU-30 control data user group joint conference, Manchester, UK, 22-25 Sep 1980)	
1	5:39203	*See* LBL-11290
CONF-800982-	(Huntsville electro-optical technical symposium, Huntsville, AL, USA, 29 Sep-2 Oct 1980)	
1	5:38522	*See* UCRL-84538
CONF-800983-	(Joint Japan/US heat transfer seminar, Tokyo, Japan, 29 Sep-3 Oct 1980)	
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80-001	5:37688	NTIS, PC A12/MF A01
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2753	5:38419	NTIS, PC A03/MF A01
2770(OP)	5:37903	NTIS, PC A02/MF A01
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2775(OP)	5:37721	NTIS, PC A02/MF A01
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159785	5:38322	*See* DOE/NASA/0027-80/1
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5462	5:38712	NTIS, PC A04/MF A01
5567	5:37746	NTIS, PC A08/MF A01
5639	5:37880	NTIS, PC A06/MF A01
5645	5:39117	NTIS, PC A12/MF A01
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5654	5:38279	NTIS, PC A17/MF A01
5655	5:38246	NTIS, PC A08/MF A01
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58	5:39206	NTIS, PC A04/MF A01
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156/V1	5:37733	NTIS, PC A20/MF A01
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6405	5:39031	NTIS, PC A05/MF A01
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7355	5:38294	NTIS, PC A02/MF A01
7386	5:38713	NTIS, PC A04/MF A01
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7398	5:37589	NTIS, PC A08/MF A01
7425	5:38113	NTIS, PC A11/MF A01
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7452	5:39109	NTIS, PC A04/MF A01
7453	5:37811	NTIS, PC A07/MF A01
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80-119514	5:37568	NTIS, PC A03/MF A01
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80-126980	5:37552	NTIS, PC A12/MF A01
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80-128473	5:38338	NTIS, PC A11/MF A01
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80-128739	5:37667	NTIS, PC A17/MF A01
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80-129083	5:38880	NTIS, PC A03/MF A01
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80-129513	5:38296	NTIS, PC A05/MF A01
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80-130800	5:38112	NTIS, PC A02/MF A01
80-131485	5:38680	NTIS, PC A09/MF A01
80-132137	5:38285	NTIS, PC A03/MF A01
80-132202	5:38221	NTIS, PC A05/MF A01
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80-133036	5:38683	Source tape is in EBCDIC character set. Tapes can be prepared in most standard 7 or 9 track recording modes for one-half inch tape. Identify recording mode desired by specifying character set, track, density and parity. Call NTIS Computer Products if you have questions. Price includes documentation, PB80-133044, and PB80-133051.
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80-133135	5:38726	NTIS, PC A99/MF A01
80-133192	5:37553	NTIS, PC A05/MF A01
80-133838	5:38686	NTIS, PC A04/MF A01
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80-1599C	5:37740	NTIS, PC A03/MF A01
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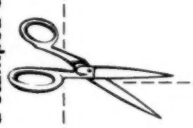

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